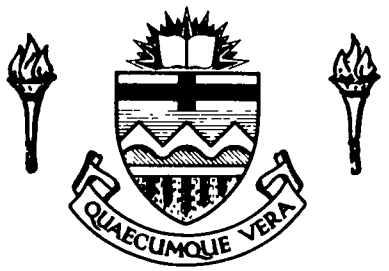
CANADIAN FRONTIERS OF SETTLEMENT

MACKINTOSH



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CANADIAN FRONTIERS OF SETTLEMENT

In Nine Volumes

Edited by

W. A. Mackintosh and W. L. G. Joerg

I. Prairie Settlement: The Geographical Setting
By W. A. Mackintosh

II. History of Prairie Settlement and Dominion Lands Policy
By A. S. Morton and Chester Martin

III. History of Immigration Policy and Company Colonization
By D. A. McArthur and W. A. Carrothers

IV. Economic Problems of the Prairie Provinces
By W. A. Mackintosh assisted by A. B. Clark, G. A. Elliott and W. W. Swanson

V. Agricultural Progress on the Prairie Frontier
By R. W. Murchie assisted by William Allen and J. F. Booth

VI. The Settlement of the Peace River Country: A Study of a Pioneer Area
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VII. Group Settlement: Ethnic Communities in Western Canada
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VIII. Pioneering in the Prairie Provinces: the Social Side of the Settlement Process
By C. A. Dawson

IX. Settlement and the Forest and Mining Frontiers
By A. R. M. Lower and H. A. Innis

VOLUME I

PRAIRIE SETTLEMENT

THE GEOGRAPHICAL SETTING

CANADIAN FRONTIERS OF SETTLEMENT

Edited by

W. A. MACKINTOSH *and* W. L. G. JOERG

IN NINE VOLUMES

VOLUME I

PRAIRIE SETTLEMENT

THE GEOGRAPHICAL SETTING

BY

W. A. MACKINTOSH

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Queen's University

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CONTENTS

ACKNOWLEDGMENTS

The members of the Canadian Pioneer Problems Committee desire to record their gratitude to the many institutions and individuals who have assisted in carrying out the programme of research of which some of the results are presented in this series. Dr. Isaiah Bowman, Director of the American Geographical Society of New York, has fathered the project from the outset, and at all stages has given wise counsel. The Social Science Research Council has, by generous grants of funds, made possible the five-year programme of research and the publication of these volumes. The Universities of Alberta and Saskatchewan and the Manitoba Agricultural College coöperated in the field surveys organized by the Committee and have given generously of the services of their staffs. The Dominion Government, through the Dominion Bureau of Statistics, the Department of Agriculture, the National Development Bureau and the Topographical Surveys Branch of the Department of the Interior, the Dominion Meteorological Service, and the Geological Survey, has rendered valuable assistance. The Canadian National Railways, the Canadian Pacific Railway, and the Provincial Governments have been equally helpful.

The Committee is greatly indebted to J. C. Cameron, M.Com., the Director's assistant, for his careful work and his untiring zeal in aiding the research. It is impossible to record the names of the many other individuals who gave of their time and counsel, and who patiently answered innumerable and not always intelligent questions.

The Committee gratefully acknowledges this assistance but retains for itself and for its contributing authors exclusive title in their own mistakes.

FOREWORD

During the past fifteen years arable land has been regarded with heightened intensity and challenge from both the politico-social and the scientific standpoints. The turning of idle land to broader social use—that is, to grow food for landless people as in the break-up of large estates in central and eastern Europe—illustrates the first of these two viewpoints. Both points of view are illustrated in the homesteading and related immigration policies of governments that still have large acreages of virgin land which may be cultivated with varying degrees of difficulty. Possibly as much as three million square miles of such land may still be found upon the frontiers of agricultural settlement in Canada, Siberia, Manchuria, Australia, South Africa, and South America, to mention the leading examples. Into them substantial streams of settlers continue to flow.

In every country that has to deal realistically and on a large scale with both land and immigration problems, all departments of government are directly or indirectly concerned. Yet few are the intensive studies that give us reliable information about such problems. A review of work under way in this field, and of publications available, makes it quite clear that an orderly and, if possible, a scientific study of the land question is a first consideration in the shaping of sound and discriminating policies with respect to the production, transport, and marketing of produce as well as to the placing of people upon the best accessible land, the education of children in pioneer communities, citizenship training, and the scale and rate of investment of public funds in the building of the roads, railways, telegraph lines, and other material elements of civilization that pioneers are now accustomed to demand.

Every country in the world with large potentiality for settlement has a wide range of interrelated problems to explore, and guiding principles are not easily found. It was therefore thought desirable to initiate a study of all regions capable of agricultural settlement or but newly settled, concentrating upon the largest and best of them on or near the margins of the belts of temperate climate. The interest and support of the Social Science Research Council made possible a beginning, and it was agreed that Canada offered

the greatest promise of success for a first study. The bonds of personal friendship, mutual professional interest in the subject, and a common language, made Canadian coöperation peculiarly attractive. A committee, composed exclusively of Canadians, was set up and given virtually complete liberty of action. The committee has exercised that liberty with excellent judgment, consulting freely on all essential matters of policy, and driving towards its objectives with all the energy it could command. The Canadian people may take pride in a piece of work so broadly conceived, so competently managed, and so adequately reported as this national study of the remaining frontier zones of settlement in the Dominion.

These nine volumes are the fruit of cooperative enterprise. They are not written as books on economics or sociology but as studies in frontier settlement through the application of technical methods employed by scholars in these and other subjects that bear on the questions which such settlement presents. The results cannot fail to provide a fresh starting-point for the consideration of a group of national questions that grow ever more urgent and that can be met only after close study of a wide range of conditions. It is a tribute to Dr. Mackintosh and his able colleagues that their field studies have been made on schedule and that they have prepared their stimulating reports so promptly and so well.

ISAIAH BOWMAN

INTRODUCTION

Toward the close of the nineteenth century a new era of settlement in Canada began. Between 1876 and 1896 population had increased by 25 per cent.; during the next twenty years it increased by 60 per cent. By 1913 annual immigrant arrivals were more than ten times what they had been in the nineties. A colonizing population overran a part of the central plain of Canada greater in area than modern Germany.

Converging events in the later nineteenth century created circumstances favourable to this era of settlement. The railway had become a potent instrument in the economic conquest of the continental interiors. The improved marine engine and steel hull of the steamship had drawn the pioneer fringes of the world closer to the industrial areas and commercial centres of the world. British free trade and its shorter-lived European counterpart had permitted the great expansion in world trade which the revolution in mechanical transport had promoted.

Before the collapse of prices in 1874 ocean freight rates on wheat from Montreal to Liverpool ranged from 18 to 20 cents per bushel; by 1904 they had fallen to less than 2 cents per bushel. When the Canadian Pacific Railway began operations in 1886, the combined transportation charges on wheat from Regina, Saskatchewan, to Liverpool were more than 35 cents; in 1906, they had fallen to 21 cents per bushel. This revolutionary decline in the cost of transport drew the wheat-growing settlers of the United States within range of European markets, but offsetting declines in the price of wheat and other farm products left the early pioneer farms of the Canadian plains still too remote to be integrated effectively in the world's commercial system. Wheat in Liverpool fell from $1.76 in 1873 to 84 cents a bushel in 1896. By 1907 it had again passed the dollar mark, and in 1913 the average price was $1.13. After 1896 the stimulus of rising prices was added to the opportunities of falling transportation rates.

By the time a favourable conjuncture of costs and prices had opened the way to the exploitation of the Canadian plains, the westward-moving agricultural frontier of the United States had gathered experience and fashioned instruments which the Canadian settler could borrow. The chilled steel plough, light but capable

of turning the tough prairie sod, had been constructed in 1870. In 1878 the invention of roller milling had converted the hardness of the spring wheat of the northern plains from a blemish to a virtue. In 1880 Appleton's improvement of the twine binder contributed to that economy of labour and speed of work which is the necessary characteristic of agriculture on the northern plains of North America. So important a contribution was the construction of mechanical grain elevators that they became as characteristic of prairie landscape as the native vegetation.

In Utah, the Mormon colony had developed by experimentation the dry-farming practice of summer fallowing without which the semi-arid plains were closed to agriculture. Elsewhere in the western United States less striking but none the less important contributions to the technique of settlement and of extensive agriculture were made. The flat furrow, the sod house, the tar-paper shack, the "dug-out" for storing water were a few among many tools of settlement borrowed by the Canadian settler from his neighbour in the United States.

It was left for the Canadian himself to develop the early-maturing wheats with which to cope with his special problem of the short growing season.

By 1890, according to the much quoted statement of the Superintendent of the United States Census, the rapid westward movement of the frontier to which de Tocqueville had attributed "the solemnity of a providential event", had ceased. For the United States it had ceased, or at least had greatly slackened, but for North America the wave had merely crossed the forty-ninth parallel into Canada, passing from the Mississippi Valley into those valleys which slope toward the Arctic. The growing scarcity of free land in the United States turned the tide of land seekers toward the Canadian West.

The nineteenth century in Europe was a century of unprecedented upheaval and change. Before the new era of settlement in Canada the first phase of the Industrial Revolution had passed and the second phase had begun. Not only Britain, but France, Germany, and the United States had entered the "Age of Steel". Agricultural and industrial populations were dislodged and given an enforced mobility. Customary occupations and employments disappeared in an age of rapid technological change. With little abatement that upheaval continued until obscured by the events of the World War. The enforced transfer of workers from one

job to another and from one industry to another to which our generation has given the name technological unemployment was a familiar phenomenon of the pre-war world. It attracted less attention then than now because, in large part, it found its solvent in the moving fringes of settlement. While no great percentage of the displaced workers was actually transferred to the pioneer agricultural areas, the numbers were sufficient to make an important contribution to the mobility of labour. Industrial and agricultural changes shook loose the workers of Europe, improved transportation gave them a hitherto unknown mobility, and the plains of Western Canada at the beginning of the new century offered opportunity.

This series of studies[1] is concerned with recent—approximately twentieth century—settlement in Canada. It is concerned chiefly with the agricultural settlement of the great central plain, the problems of which exceeded in scope and significance those of any other Canadian region. Some attention is given, however, to those contrasting problems of settlement which emerge in the forest and mining regions of Ontario, Quebec, and British Columbia.

The settlement of a pioneer area is carried out by many individuals driven by the most diverse motives; of these the economic is by no means dominant. Successful settlement, however, can only be achieved if an adequate income is possible—adequate in providing a reasonable standard of living, and adequate in comparison with alternative incomes. To ensure adequate incomes, access to expanding markets is essential, and land suited to the production of the marketable commodities. Land can be deemed suitable only if there have been developed arts of utilizing the particular types of land available. The land must be sufficient in quantity to support a volume of production and a density of population capable of maintaining the economic, social, and governmental services which are deemed essential. Where these conditions are not fulfilled, settlement fails and is succeeded by poverty, abandonment, and deterioration.

[1] The volumes present some of the results of research carried on by the Canadian Pioneer Problems Committee since its organization in 1929. The members of the Committee are: William Allen, Professor of Farm Management, University of Saskatchewan; C. A. Dawson, Professor of Sociology, McGill University; D. A. McArthur (Chairman), Professor of History, Queen's University; Chester Martin, Professor of History, University of Toronto; R. W. Murchie, Professor of Sociology, University of Minnesota (formerly of the Manitoba Agricultural College); R. C. Wallace, President of the University of Alberta; and W. A. Mackintosh, Professor of Political and Economic Science, Queen's University (Director of Research). The Committee was deprived through his death in 1930 of the services of its original chairman, W. J. Rutherford, Dean of the Faculty of Agriculture, University of Saskatchewan. D. A. MacGibbon, formerly Professor of Economics, University of Alberta, resigned from the Committee on being appointed to the Board of Grain Commissioners.

The homesteader on the Canadian prairies often referred to the homestead entry fee of ten dollars as a wager with the government that he could stay on his homestead for four years. This did not inaccurately describe the situation of men who faced new conditions with but little dependable knowledge or experience. The pioneer is an experimenter. Without knowledge, he is a gambler. Some of the conditions of success are unpredictable, but many can be determined by scientific inquiry. So much human welfare is at stake, so much government expenditure is involved, so much private capital is risked in the settlement of a new area, that here if anywhere is a case for social planning.

It is not hoped in these studies to lay down plans for future Canadian settlement. Satisfactory accomplishment of such a project would require greater resources and longer time than the group of contributors to these volumes have had at their disposal. It is hoped, however, to show the need, scope, and direction of such planning. The whole record of Canadian settlement in this period is examined, its successes and its failures are noted, and its peculiar problems are analysed.

The scope of the studies includes:

(1) An examination of the physical basis of settlement, the possibilities which those responsible for settlement policy saw in them, the actual extent and pattern of settlement that was achieved, and the prospects of future development.

(2) The historical record of the process of settlement—an examination of the succession of experiments out of which knowledge was gained and security increased; the land policies and the immigration policies designed to bring land and people together; the agencies through which people were placed on the land.

(3) The evolution of farming and the economic progress of the settlers; probable trends of future development.

(4) The social structure of the region and the social progress of the settler.

(5) The economic problems of a pioneer region exporting raw materials to world markets and importing capital; a study of fluctuating incomes and the importance of private and community overhead costs.

(6) The Peace River Country, a present-day frontier.

(7) The records of distinctive racial and religious groups as settlers.

(8) The settlement problems of the forest and mining regions.

The whole series of studies will provide, it is hoped, an examination of the conditions and processes of settlement as exemplified in contemporary Canadian experience and will make some contribution toward the development of economic and social planning in a field where the costs of planless development are peculiarly heavy.

The history of settlement in Canada is not closed. Though the volume and momentum of pre-war settlement may never be duplicated, the margin of settlement will continue to move into new areas. That extension will not proceed at a constant rate; it may involve successive advances and retreats as world economic conditions dictate. The areas which will be settled will not be areas of superior land but of marginal land previously passed by and now, with fresh knowledge, new implements, and favourable economic circumstances, capable of settlement. Here the costs of haphazard settlement are certain to be heavy. The difficulties of land selection and of land utilization will be greater than those experienced in the past; the problem of building compact settlements capable of providing the necessary social services will become more difficult. Transportation and governmental services can be provided in the area of sparse settlement only at the expense of the mature communities with greater density of population. The need for the systematic planning and control of settlements, if heavy financial and human costs are to be avoided, is likely to be greater in the future than it has been in the past.

W. A. MACKINTOSH

CHAPTER I

THE LAND AND ITS CLIMATE

IN the years before Confederation (1867) it was becoming increasingly apparent that British North America, and the Province of Canada in particular, was facing more than one critical decision. Agricultural settlement had already covered the available lands of the Maritime Colonies and of the St. Lawrence Valley. Under the stimulus of high prices for grain and lumber an attempt had been made to push back the northern boundaries of settlement. The extent to which that attack was to fail was not then apparent, but it was obvious that extension in that direction was limited. To the south, the people of the United States were pressing westward beyond the Mississippi into the new Northwest. Was settlement of Canada to be confined to the East, or was there a Canadian Northwest comparable in extent and promise to the United States Northwest?

In 1856, the date of the last census before its purchase by Canada, the territory of the present provinces of Manitoba, Saskatchewan, and Alberta (an area of 2,000,000 square miles), contained 6,691 persons in addition to Indians; of this number probably more than 5,000 were half-breeds. Less than 9,000 acres of land were under cultivation. The Indian population numbered less than 50,000. The whole area was given over to the fur trade, with some subsidiary agriculture. Including Indians, it supported about one person to every 36 square miles. In 1931 the same area had a population of 2,354,000, or more than one to the square mile. An economic and social organization based on the fur trade had given way to an agricultural and industrial economy capable of supporting within the same area more than 36 times as many people as did the economy of 1856.

As early as 1812 the Selkirk Settlement had been established in the valley of the Red River, but the life of the settlement was precarious and its power to expand feeble. In 1831 there were only 2,390 inhabitants, of whom probably more than two-thirds were half-breeds.[1] The next forty years passed with little increase.

[1] "Census of Assiniboia, 1831," Censuses of Canada, 1665-1871, *Census of Canada, 1870-71*, Vol. IV (Ottawa, 1876).

In 1871, according to the official census of that year, the new Province of Manitoba, excluding the Territories, had a population of 12,000 people, of whom all but 1,565 were half-breeds. Settlements at trading posts in the Territories were made up chiefly of half-breeds.

The following table (Table I) shows how insignificant relatively was the agricultural population in the early years of settlement.

TABLE I—POPULATION AND LAND UNDER CULTIVATION IN PRESENT AREA OF MANITOBA, SASKATCHEWAN, AND ALBERTA.

	POPULATION	LAND UNDER CULTIVATION (acres)	ACRES PER CAPITA
1831*	2,390	2,152	9
1835*	3,649	3,504	1 0
1840*	4,704	4,041	.9
1846*	4,871	5,380	1.1
1849*	5,391	6,392	1.2
1856*	6,691	8,806	1 3
1871*	12,228	.. ...	...
1871†	73,228	.....	...
1881†	122,400	279,249	2 3
1891**	251,473	1,428,884	5.7
1901††	419,512	5,592,601	13 3

* *Census of Canada, 1870-71*, Vol. IV.
† *Census of Canada, 1880-81*, Vol. III.
** *Census of Canada, 1890-91*, Vol. II.
†† *Census of Manitoba, Saskatchewan, and Alberta, 1926*
} Include Indians for the whole of the Northwest Territories.

Actual settlement of the Canadian Northwest followed the decision of the Canadian Government that expansion of settlement westward was a logical and desirable policy, and that the agricultural possibilities of the country were too great to admit of its being reserved any longer for the fur trade. This decision and its necessary complement, the decision to build a transcontinental railway, was reached only after extensive investigations had been made of the agricultural resources. The decision rested on the conviction that the area could be converted to successful agricultural settlement.

True, other factors were important. The inadequacy of government by the Hudson's Bay Company, the suggestion that the country should be annexed by Minnesota, the agitation of the "free-traders" against the fur monopoly—these also were significant

factors. Nevertheless, the settlement of the Canadian plains was a clean-cut experiment in agricultural colonization.

This experiment began in 1870. Prior to 1870 the fur trade and the buffalo, purveyor to the fur trade, reigned supreme; after 1870, though progress was slow, agricultural settlement was the unquestioned policy. This decision, which marked the beginning of a new historical chapter, was recorded in the Rupert's Land Act[2] which empowered the Canadian Government to acquire by purchase the territories of the Hudson's Bay Company (Fig. 30). On July 15, 1870, the region was transferred to Canada.

In what sort of land was this experiment set up? With what facts of climate and resources was the incoming settler confronted? What were the anticipated results? What was the actual outcome? It is the purpose of this volume to sketch the physical characteristics of the region, to record the opinions of those who forecast its probable development, to show the development which actually took place, and to indicate the importance of the part played by the physical factors.

. . . . . .

The area of agricultural settlement, with which we are concerned, is essentially the northern part of the great interior plain of North America (Fig. 2). From a base 800 miles along the forty-ninth parallel, it extends northward between the Rocky Mountains on the west and the Precambrian "Shield" on the east, to reach the Arctic Sea on a 450-mile front embracing the Mackenzie delta. Though the settled portion of the plain is typically grassland, population has extended on the east and north into wooded areas.

The Canadian or Precambrian Shield, lying between the continental plain and Hudson Bay, is a country of igneous rock and coniferous forest (for boundary, see Fig. 2). It is characterized by worn-down rounded hills almost denuded of soil, precipitous rivers, and innumerable lakes, swamps, and muskegs. Its soil is usually sandy, except where lakes formed by the retreating glacier of the Ice Age have deposited sediments to make the soils of the clay belts of northern Manitoba, Ontario, and Quebec. Shunned by the agricultural settler this region has passed from the fur trade to the mining and forest industries. Agriculture will always be restricted there to small proportions by the inferior soil,

[2] *Statutes of the United Kingdom*, 31-2 Victoria, cap 105, 1868.

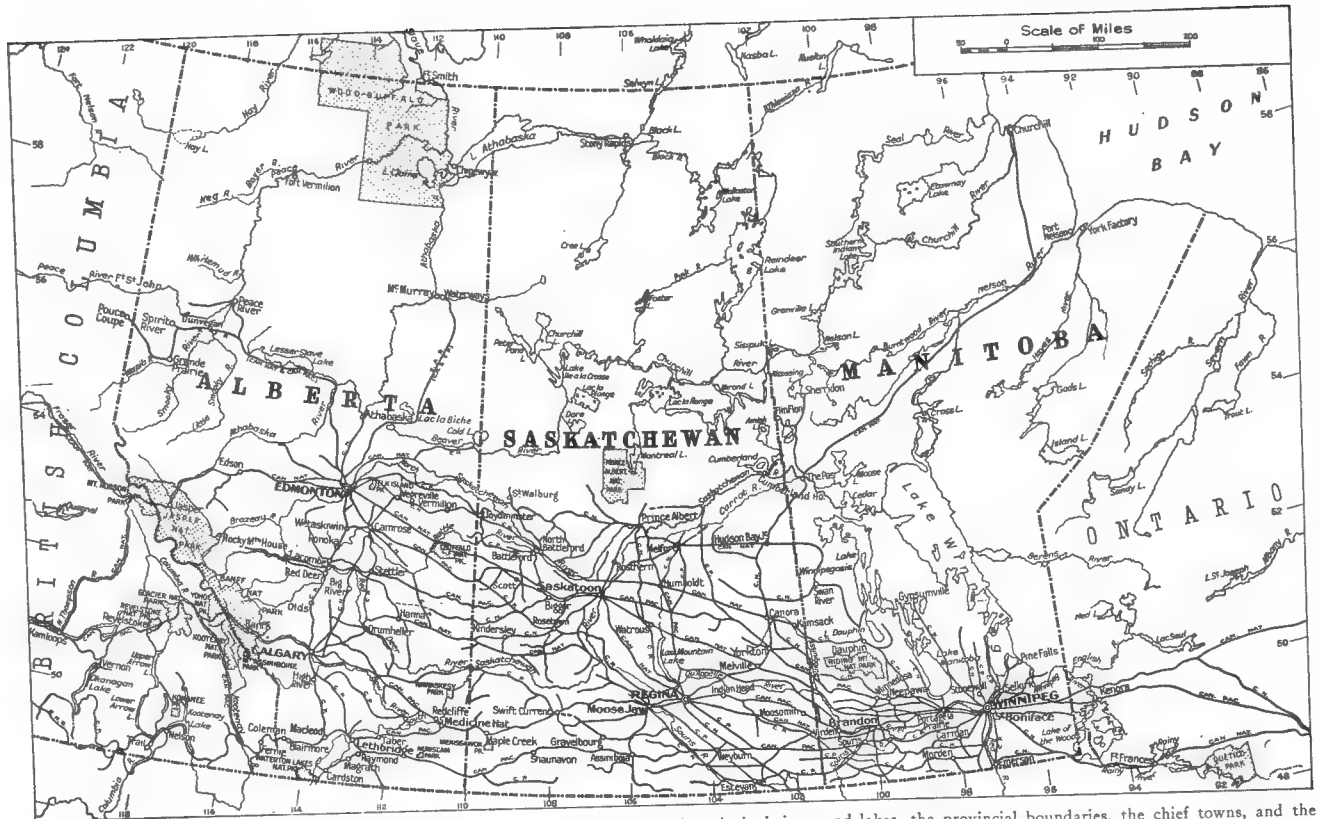


FIG. 1—General locational map of the Prairie Provinces of Canada showing the principal rivers and lakes, the provincial boundaries, the chief towns, and the railways (based on map in *Agriculture, Climate, and Population of the Prairie Provinces of Canada: A Statistical Atlas Showing Past Development and Present Conditions*, prepared under the direction of W. B. Hurd and T. W. Grindley, 1932, Ottawa, Dominion Bureau of Statistics—hereafter referred to as *Statistical Atlas*).

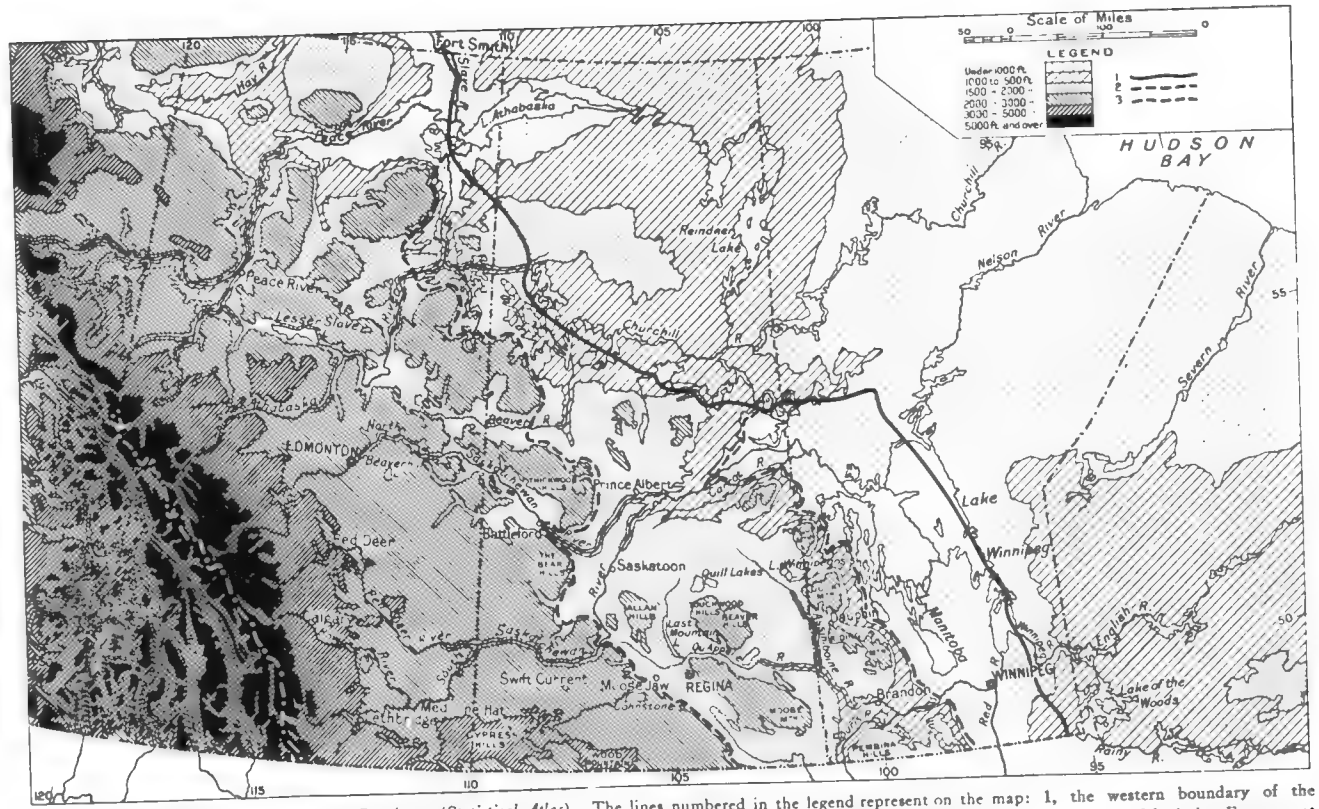


FIG. 2—Relief map of the Prairie Provinces (*Statistical Atlas*). The lines numbered in the legend represent on the map: 1, the western boundary of the Precambrian Shield; 2 and 3, respectively the boundaries between the first and second and between the second and third prairie levels (i.e., the Manitoba Escarpment and the Missouri Coteau).

short growing season, and small local markets. Where other industries have established settlements, a small agriculture supplying a local market usually develops. Agricultural settlement, however, in this region will always be subordinate to other industries.

The Canadian section of the continental plain lies almost wholly in two drainage basins (Fig. 2). South of the 54th parallel, the

FIG. 3—Red River Valley near Portage La Prairie. Note the level topography and the absence of rough land. (Canadian National Railways.)

Nelson-Saskatchewan basin extends to the international boundary. To the north, the Mackenzie-Athabaska-Peace embraces the great plain. Only a small corner is drained by the Churchill through its tributary the Beaver. The great rivers of the region rise in the Rocky Mountains and derive but little of their water from the areas of scanty precipitation through which they flow. In depressions between the great river basins surplus water drains into sloughs or lakes. These fill up in the spring and either disappear or are greatly reduced in size by evaporation in the summer. The water of such lakes is usually strongly alkaline. Frequently at mid-summer little remains of a comparatively large

lake except the white alkaline deposits in its bed. Very considerable areas depend on internal drainage. Johnstone and Chaplin Lakes, Quill Lake, Long Lake, and many smaller ones are centres of internal drainage in the province of Saskatchewan.

As it stretches from the valley of the Red River to the foothills of the Rockies, this great plain presents within itself marked diversity. In the south three levels are easily distinguished

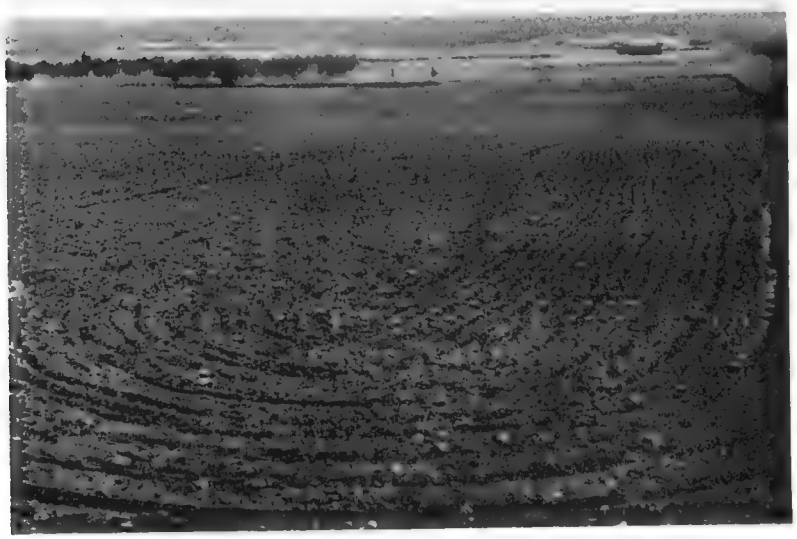


Fig. 4—The Swan River Valley in the Park Belt (Canadian National Railways).

(Fig. 2). To the north, the first two disappear at the boundary of the Precambrian. The flat, featureless, and fertile Red River Valley (Fig. 3) together with the Manitoba lakes constitute the first prairie level, which has an average altitude of about 800 feet. The first prairie level corresponds closely to the bed of the glacial Lake Agassiz, from whose sediments came the "black-earth" soil of the Red River Valley. The western boundary of this level, rising to more than 2,000 feet, is the Manitoba Escarpment, which is divided by the eastward-flowing rivers into the Pembina, Tiger, Riding, Duck, Porcupine, and Pasquia Hills.

West of the Manitoba Escarpment is the second prairie level,

a rolling plateau of an average altitude of about 1,600 feet, scored by deeply trenched rivers and marked by frequent level lake-bottoms. Its western limit is the Missouri Coteau, somewhat west of a line drawn through Weyburn and Moose Jaw. Here a ridge of "dirt hills" rises 300 to 500 feet above the second prairie level and extends northwest in successive ranges of hills to meet the Precambrian Shield near Lake Athabaska.

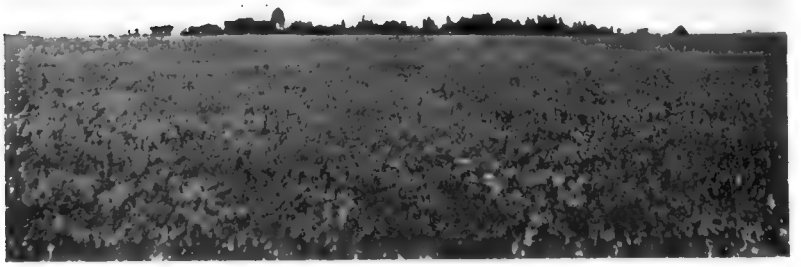
Between these and the foothills of the Rockies the third prairie level slopes eastward and northward, from an altitude of 4,000 feet at the foothills to 2,200 feet at the eastern and northern limits. Its surface varies from rolling to hilly. Erosion has proceeded further than on the other levels and, in some areas, the plateau has been worn down into characteristic bald rounded hills. Near the rivers deep "draws" and "coulées"[3] give rise to local "bad lands". Eroded remnants of old table-lands, such as Wood Mountain and the Cypress Hills, rising 1,000 to 2,000 feet above the surrounding country, form areas of "rough country" more suited to ranching than to grain farming. Aside from the ranges of hills which separate the three levels, broken topography becomes more frequently an obstacle to settlement as one moves west from the first to the third level (Figs. 9, 10, 11).

The whole of the plain of Western Canada slopes eastward and to the north. From the base of the Rockies to Lake Winnipeg the fall is more than five feet to the mile. Rivers are usually rapid in flow, but there are, nevertheless, as pointed out, numerous areas where the drainage is poor or where only internal drainage exists.

Settlers coming to the Canadian Northwest found extreme temperatures and scanty precipitation.[4] In eastern Canada little agriculture exists north of the forty-ninth parallel, which forms the southern boundary of western Canada. In western Canada commercial agriculture is established north of latitude 58°N. and gardens are successfully cultivated within the Arctic Circle. It is only the great northward sweep of the summer isotherms which makes this possible (Fig. 14). Olds, Alberta (51°40′N); Lloydminster, Alberta (53°30′N); Dunvegan, Alberta (56°N); Fort Vermilion, Alberta (58°30′N);. and Fort Good Hope, N.W.T.

[3] Coulées are dry ravines or gulches. draws or breaks are eroded clefts or ravines in the banks of rivers.

[4] The published meteorological records for 1917 and earlier are to be found in A. J. Connor, *The Temperature and Precipitation of Alberta, Saskatchewan, and Manitoba* (Ottawa: The Meteorological Service of Canada, 1920) with 16 maps on the scale of 35 miles to the inch: monthly mean daily maximum and minimum temperatures; mean precipitation for April and May, June and July, and August and September combined respectively; mean annual precipitation. For later records see *Monthly Record of Meteorological Observations in Dominion of Canada and in Bermuda and in Newfoundland*, issued by the Meteorological Service of Canada, Central Office, Toronto (Ottawa: King's Printer).



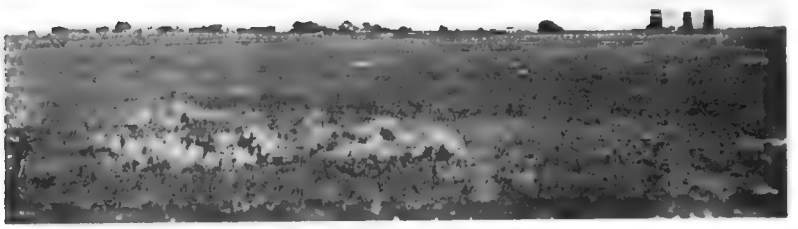
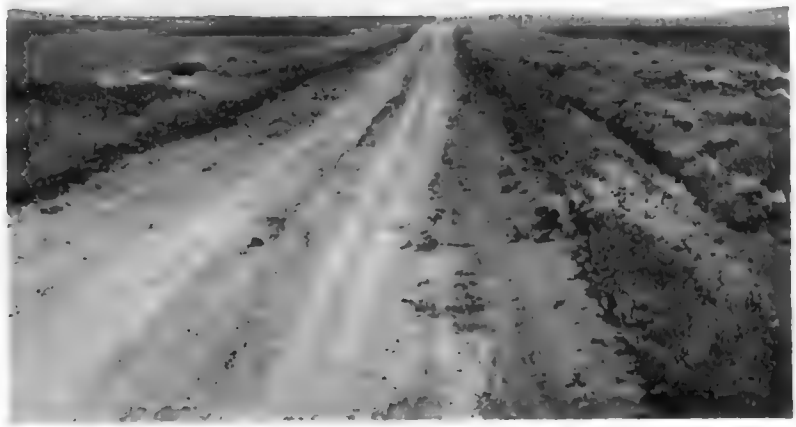


FIG. 5—The Park Belt at Melfort, Saskatchewan. Note the "bluffs" (see footnote 10), mainly poplar.

FIG. 6—The Regina Plains on the second prairie level and in the dark brown prairie soil belt. The level topography and heavy clay soil suggest a former lake bottom. Trees planted to form a "windbreak".

FIG. 7—A village on the semi-arid plains in southwestern Saskatchewan. Note the short grass, the sage-brush, and the grain elevators. (Figs. 5, 6, 7 are from Saskatchewan Soil Surveys.)



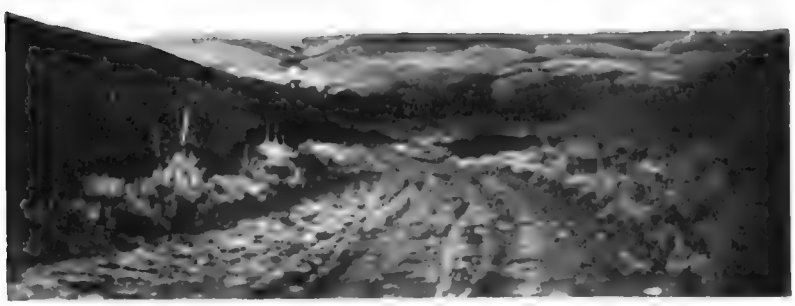
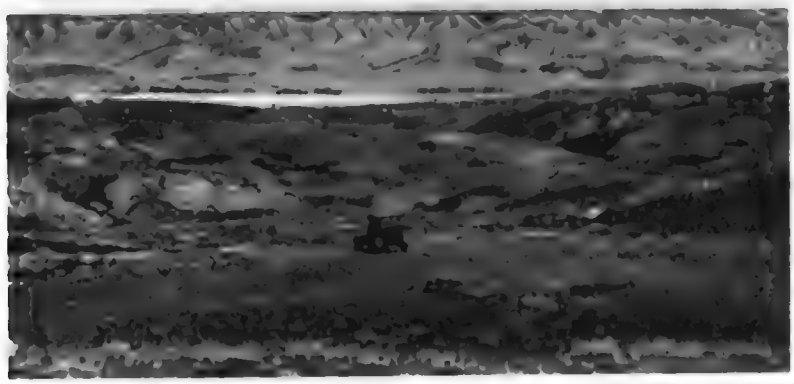


FIG. 8—Semi-arid country on the third prairie level in southern Alberta. The rolling topography, short grass, and sage-brush are characteristic.

FIG. 9—Hilly topography on the third prairie level near Irvine, Alberta.



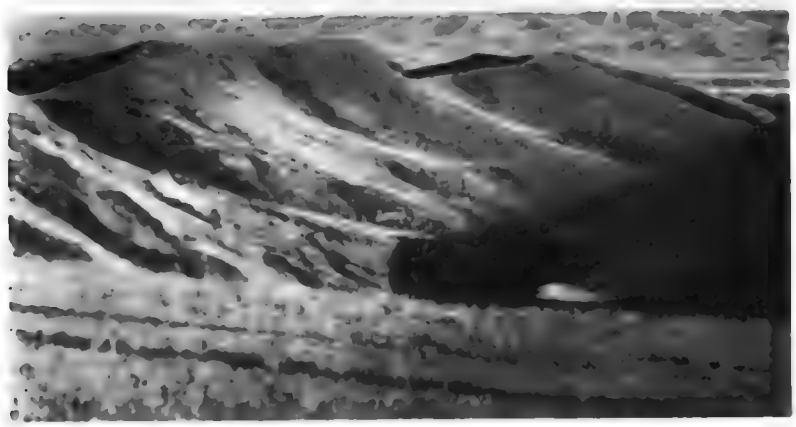


FIG. 10—"Bad lands" along the Saskatchewan River on the third prairie level. Note the extent of the erosion. (Saskatchewan Soil Surveys.)

FIG. 11—Rough, eroded lands along the Frenchman River near the international boundary in southwestern Saskatchewan (Saskatchewan Soil Surveys).

66°15′N), all have a mean July temperature of 60°F. as compared with similar temperatures of 66° at Toronto and 64° at Winnipeg.[5] Over a north to south distance of more than a thousand miles the mean July temperature is the same. The climatic axis of the Northwest lies along a belt extending approximately from south-

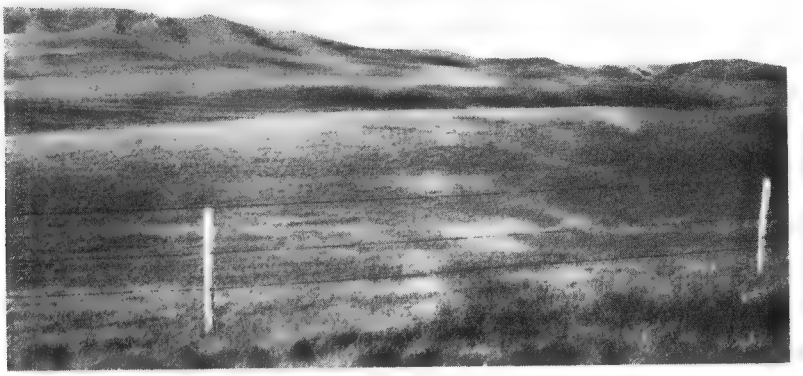


Fig. 12—Hilly range land west of the Cypress Hills.

western Manitoba to the Yukon Territory. Along this axis, making allowance for local variations, summer temperatures are considerably higher than at points of similar latitude on either side of it, and winter temperatures are considerably lower (Figs. 14 and 15). Roughly along this line also, the differences between summer temperatures and winter temperatures are greatest. Following the lines of summer temperatures the northern boundaries of the vegetation belts (Fig. 23) swing far down the valley of the Mackenzie. The northwestern coniferous forest disappears about latitude 53° on the eastern boundary of Manitoba, while it extends to latitude 61° just east of the Rocky Mountains. Similarly, the sub-arctic forest, which gives way to the arctic prairie, or

[5] *Canada Year Book, 1931* (Ottawa: Dominion Bureau of Statistics, 1932), pp. 50-53.

tundra, about latitude 60° on Hudson Bay, extends virtually to the mouth of the Mackenzie at latitude 69°. Spring begins as early in the valley of the Peace as it does in the valley of the Red, though winter comes a little earlier. Garnet and Reward wheat can be matured 750 miles north of the international boundary in Alberta, but probably not more than 350 miles north on the Saskatchewan-

FIG. 13—Ranch house in the Alberta foot-hills (Alberta Soil Surveys).

Manitoba boundary. Agricultural settlement on the Canadian plains has followed the isotherms west and northward.

Over the whole of this region moisture is scanty. The annual precipitation (Fig. 16) is 20 inches or less. In most areas, at most times, there is sufficient for agricultural needs, but always it is the critical point in farming. The whole area falls within the sub-humid and semi-arid belts. The area of least precipitation lies northwest of Medicine Hat, less than 11 inches annually being normal.

The effectiveness of precipitation, however, depends not so much on the annual total as on the amount which falls during the growing season[6] (Fig. 17). It is highly characteristic of this region that a

[6] Early recognition of this is recorded in a map of Canada showing precipitation from April to August inclusive, 1915, *Canada Year Book, 1915* (Ottawa: Dominion Bureau of Statistics, 1915), facing p. 137.

high proportion of the annual rainfall comes in the growing season. This proportion increases slightly as one goes from the sub-humid to the semi-arid sections. At Winnipeg, of a normal annual rainfall of 20.4 inches, 12.4 inches fall between April first and September first: at Medicine Hat, of a normal rainfall of 12.8 inches, 8.3 inches fall in the growing season. Thus, though the annual rainfall at Winnipeg is 160 per cent. of that at Medicine Hat, Winnipeg's warm season rainfall is only 150 per cent. of that of Medicine Hat.

Spring and summer rainfall are associated with the northeastward retreat of the polar front in the spring.[7] Thus the spring rains occur earliest in southwestern Alberta and later as one moves northeast toward Hudson Bay (Fig. 18).

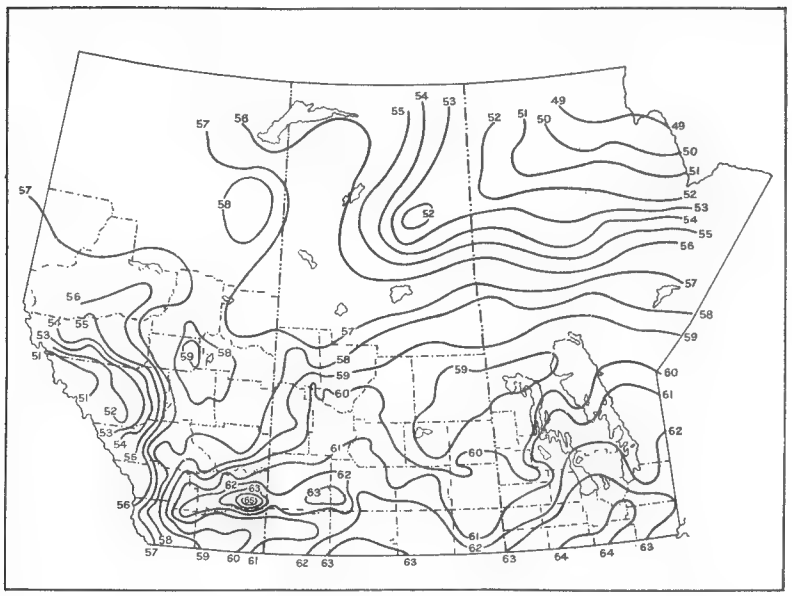
Adequate moisture for farming depends as much on the rate of evaporation as on the rate of precipitation. Unfortunately, accurate measurements of evaporation in the Canadian West are not available. It is clear, however, that 12 inches annual rainfall at Fort Vermilion in the lower Peace River Country leaves more retained moisture than the same amount of rainfall at Medicine Hat or in Montana. It requires almost twice as much water to produce a ton of dry alfalfa at Dalhart, Texas, as at Newell, South Dakota,[8] and presumably the amount is still less in more northerly latitudes. Thus the scanty rainfall of southwestern Saskatchewan and southeastern Alberta is still more scanty in effect when subject to the intense evaporation caused by hot, dry winds which occur in June and July during "bad years".

Rainfall deficiency is perhaps the most important single fact in the life on the Canadian plains. It divides the history of settlement into "good" and "bad" years. It has been the chief conditioning factor of agricultural practice. In most years rainfall is deficient only in the sense that it is not adequate except for drought-resisting crops on land tilled by moisture-conserving methods. It is approximately true to say that over nearly the whole of the West the agricultural economy is focussed on the conservation of moisture.

What drought is to the southwest, frost is to the north. As the settler advanced into the "dry belt" equipped with a knowledge

[7] Sir Frederick Stupart, "The Factors Which Control Canadian Weather", *Canada Year Book, 1925*, pp. 36-40.

[8] H. L. Shantz, "Vegetation of the Great Plains", *Annals of the Association of American Geographers*, XIII (No. 2), 82.



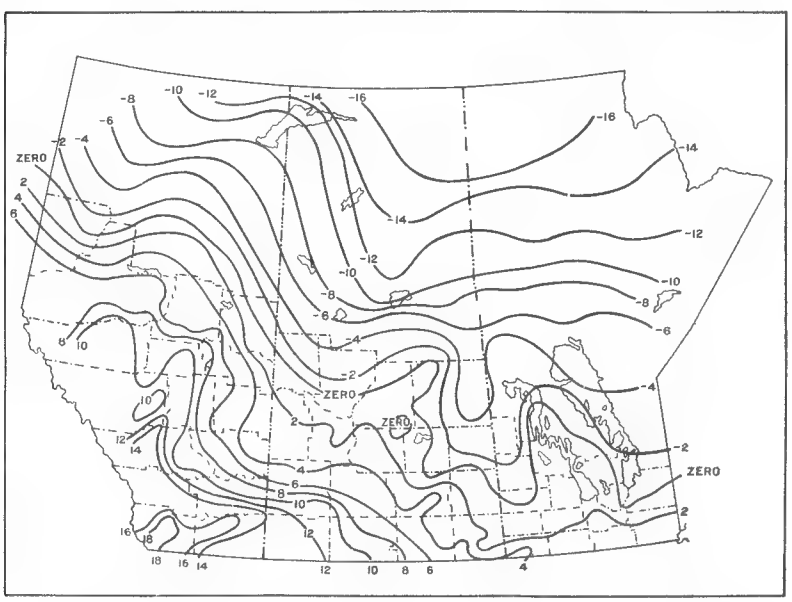
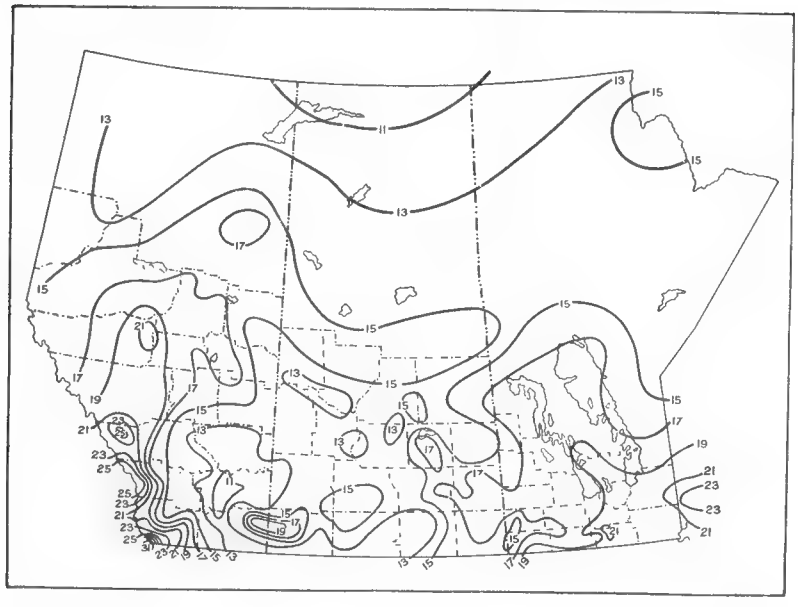


FIG. 14—Mean summer temperature (F°) June, July, and August (*Statistical Atlas*).
FIG. 15—Mean winter temperature (F°) December, January, and February.



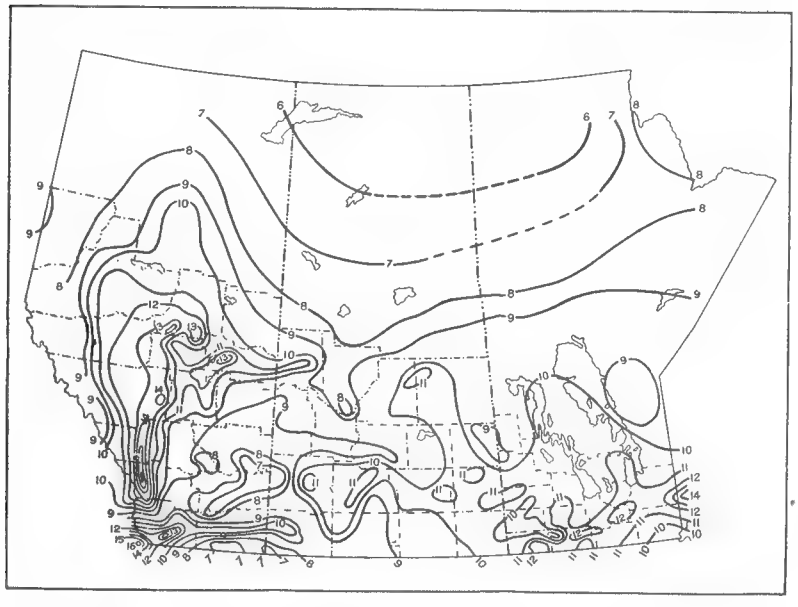


FIG. 16—Mean annual precipitation in inches (*Statistical Atlas*).

FIG. 17—Mean warm-season precipitation (April 1st to Sept. 1st) in inches (based on map in *Statistical Atlas*).

of dry farming, so he has moved north armed with early maturing grains. The customary map showing the frost-free period (Fig. 21) is to a large extent invalid to show the northern limits of cultivation. Crops are grown successfully in areas recorded as having a frost-free season shorter than the period required for maturing

FIG. 18—Months of maximum precipitation in Canada (based on map in *Canada Year Book, 1926*, p. 43).

crops. Spring frosts are not highly dangerous to growing cereal crops; they are not often "killing" frosts. Summer frosts are the chief danger. The map showing the period between the average date of seeding and the first killing frost is consequently a much more significant map (Fig. 22).

Climatic information is customarily stated in terms of averages and normals. The agricultural settler, however, does not live by averages, annual or seasonal, but from day to day and from season to season. He deals with climate as a matter of probability. He is affected not only by the normal occurrence of rain but by the departures from normal. The variability of climatic conditions is more important than their average occurrence (see Chap. IX and Figs. 144-150). It is possible for crops to be frozen three years out of five in an area which has an *average* frost-free period longer than

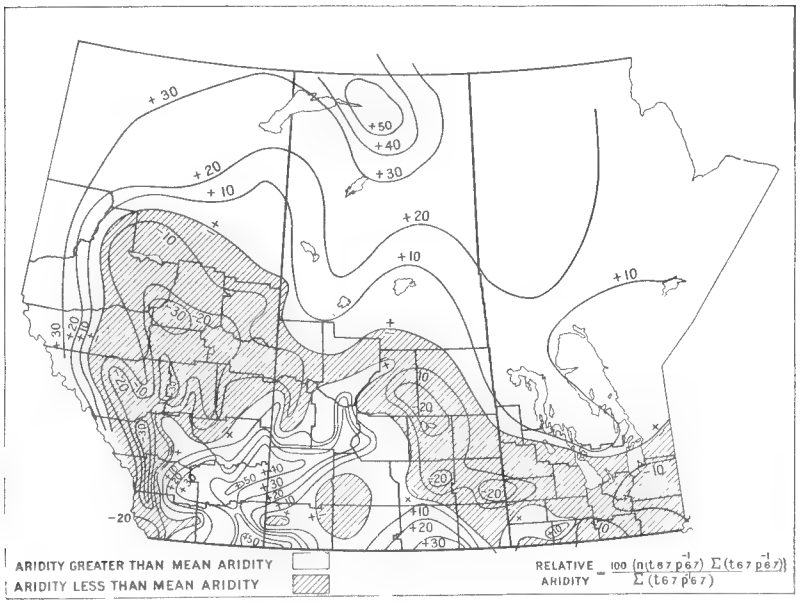


FIG. 19

FIG. 20

FIG. 19—Comparative aridity (*Statistical Atlas*). Depletion of soil moisture and injury to crops and pastures vary directly with excessive heat and inversely with the rainfall. (*Continued on next page*)

the required growing season. Dry farming may be a paying business in one area with an average warm-season rainfall of 10 inches and not in another. Life in the Prairie Provinces adapts itself not only to certain climatic normals but to the degree of climatic variability.

The vegetation belts of this region (Fig. 23) are closely correlated with precipitation and the length of the growing season. North of a line drawn from the mouth of the Mackenzie to Churchill on Hudson Bay lies the tundra, or the "arctic prairie" (Fig. 158). Treeless, except in favoured locations, it produces in the short growing season of long days a varied growth of arctic grasses, shrubs, mosses, and lichens. Scanty in the uplands and more luxuriant in the valleys, the vegetation is ample to support the caribou and the musk-ox[9]. South of the Mackenzie-Churchill line is the sub-arctic forest, consisting of aspen, poplar, canoe-birch, balsam, and spruce. The stands are not so thick as farther south, nor the trees so large. Still farther south lies the north-western coniferous forest, composed of spruce, poplar, tamarack, balsam, and aspen, with jack pine on the sandy ridges (Fig. 26).

South of the forest country the "grove belt" or "park belt", a fertile grassland, is dotted with so-called "bluffs"[10] and patches of woodland. Generally speaking, the Park Belt has an annual precipitation of 15 inches or more. The native grasses are of the tall prairie-grass types (Fig. 5).

[9] F. H. Kitto, *The North West Territories* (Ottawa Department of the Interior, 1930), pp 14-20.

[10] In local nomenclature a "bluff" is a small patch of woodland appearing in an otherwise grassland area. Varying in size from a few square rods to several acres, it may occupy a piece of rough land or a depression

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To give a graphic representation of the average variation of this combination of factors over the Prairie Provinces resort was had to the following scheme The average mean daily highest temperature in June and July over a period of years at all recording points was divided by the average rainfall for the same period. The resulting quotients were entered upon a map at their proper points. The average value of the quotient for the present grain belt was then determined by graphical integration. The percentage-proportion which every point-quotient bore to the general average was then determined and entered again upon a map The regions where the tendency to aridity is greater than the normal are distinguished by the shading from the regions where summer conditions average better.

FIG. 20—Climatological index of comparative fertility (*Statistical Atlas*) A considerable portion of the region with comparatively low aridity is not well suited for the cultivation of spring wheat on account of the danger of late or early frost or both The beginning as well as the end of the season, has been in many years subject to very cool nights, which tend to lengthen the season required for maturity beyond the number of days which the same variety of wheat requires in a warmer region. In the comparatively arid region, on the other hand, wheat is generally favoured with weather at the beginning and end of the season which assures a steady rate of growth Maturity without much danger of damage from frost, and generally better quality of kernels, are characteristic of the more arid areas.

The simplest method of taking into account this additional factor is to weigh each of the point-quotients noted in Fig 19 by the average length of the season free from killing frosts at each point. After graphical integration over the cultivated area, the average value of all weighted point-quotients was known. The proportion which each weighted point-quotient bore to the general average was entered upon a map. The resulting map depicts the comparative fertility solely upon a weather basis.

Between the crescent-shaped Park Belt and the international boundary is the area which Canadians call the prairie, the "true prairie", or sometimes the "dry belt", a northward extension of the Great Plains region of the United States. This is wholly grassland, except for such small wooded spots as the Cypress Hills, Wood Mountain, and the southern banks of the deeply trenched river channels. For the most part, the annual precipitation ranges from 15 inches at the edge of the Park Belt to 11 inches or less in the most arid part. The vegetation varies from tall prairie grasses at the border to the short prairie grasses throughout the greater part of the area, and to characteristic desert plants, sage brush, and cactus, in the driest sections (Figs. 7 and 8).

Settlers coming to Western Canada found unfamiliar soils. Peculiar climate and vegetation had over the ages built up soils of great fertility quite unlike the familiar wooded soils of the east. Soils in their maturity are the products of climate and vegetation, and the soil belts of the Canadian prairies (Fig. 24) correspond closely to the vegetation belts. The soils of the Great Plains or "prairie" region of North America are characterized, according to Marbut, "by (1) the presence, on some horizon of the soil section or profile, of a zone of alkaline salt accumulation, usually, not exclusively, lime carbonate, and (2) a relatively dark surface soil".[11] As a rule, the surface colour becomes lighter and the zone of alkaline salt accumulation occurs at shallower depths as one goes from the areas of heavier to those of lighter rainfall. The soils of the region are conspicuously high in the essential plant foods, nitrates, lime, and potash.

Encircling the border of the Great Plains occur the timber soils, which differ markedly from the grassland soils in having but a thin layer of organic matter on the surface and a second or third layer of whitish, badly leached soil of a depth of from 4 to 12 inches. At greater depth occurs the same zone of carbonate accumulation found in prairie soils (compare Figs. 117 and 118). These soils are particularly deficient in nitrogen. They are generally acid in reaction, except in areas such as that around the Manitoba lakes, where the soils are immature and formed of highly calcareous materials.

The very dark brown soils of the Park Belt are distinguished not only by the darkness of the surface soil (black except in

[11] C. F. Marbut, "Soils of the Great Plains", *Annals of the Association of American Geographers*, XIII (No. 2), p. 42.

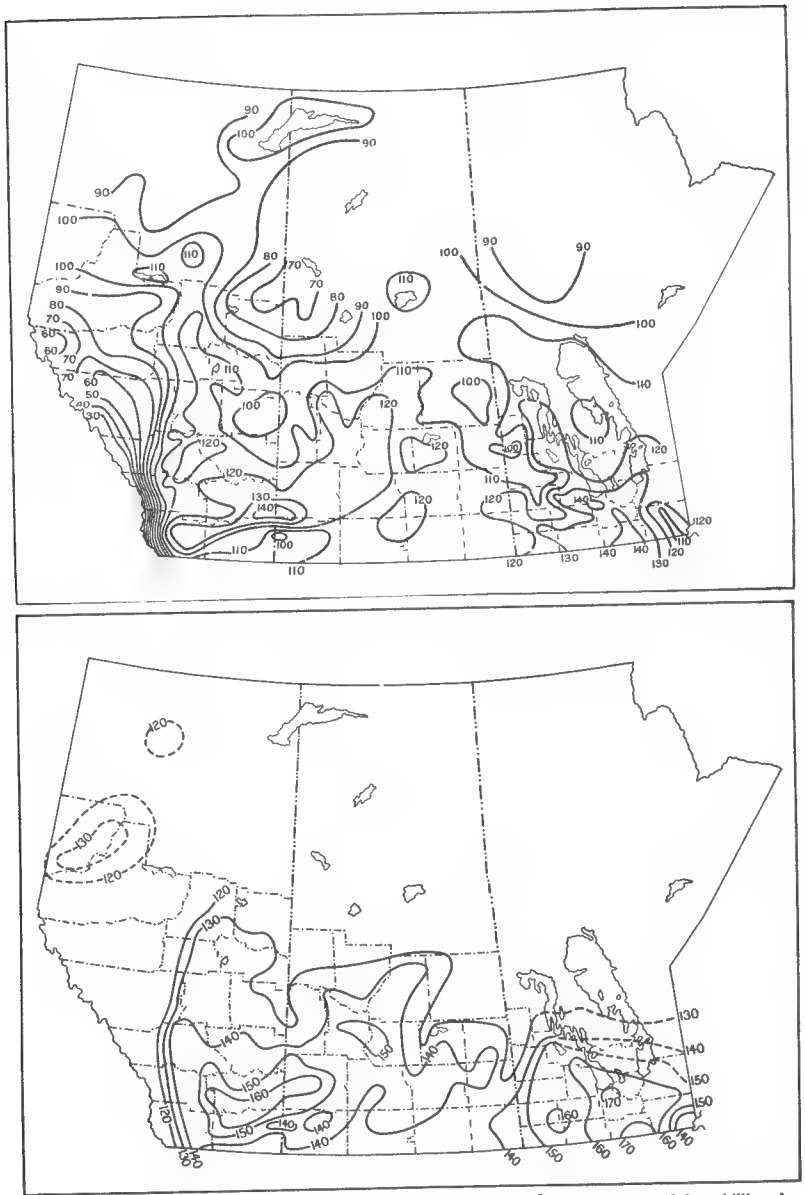


FIG. 21—Mean number of days between last killing frost (29°F.) of spring and first killing frost (29°F.) of fall (*Statistical Atlas*).

FIG. 22—Mean number of days between date when seeding becomes general and the date of first killing frost (29°F.) of fall (compiled from data supplied by National Development Bureau, the Dominion Bureau of Statistics, and the Meteorological Service of Canada).

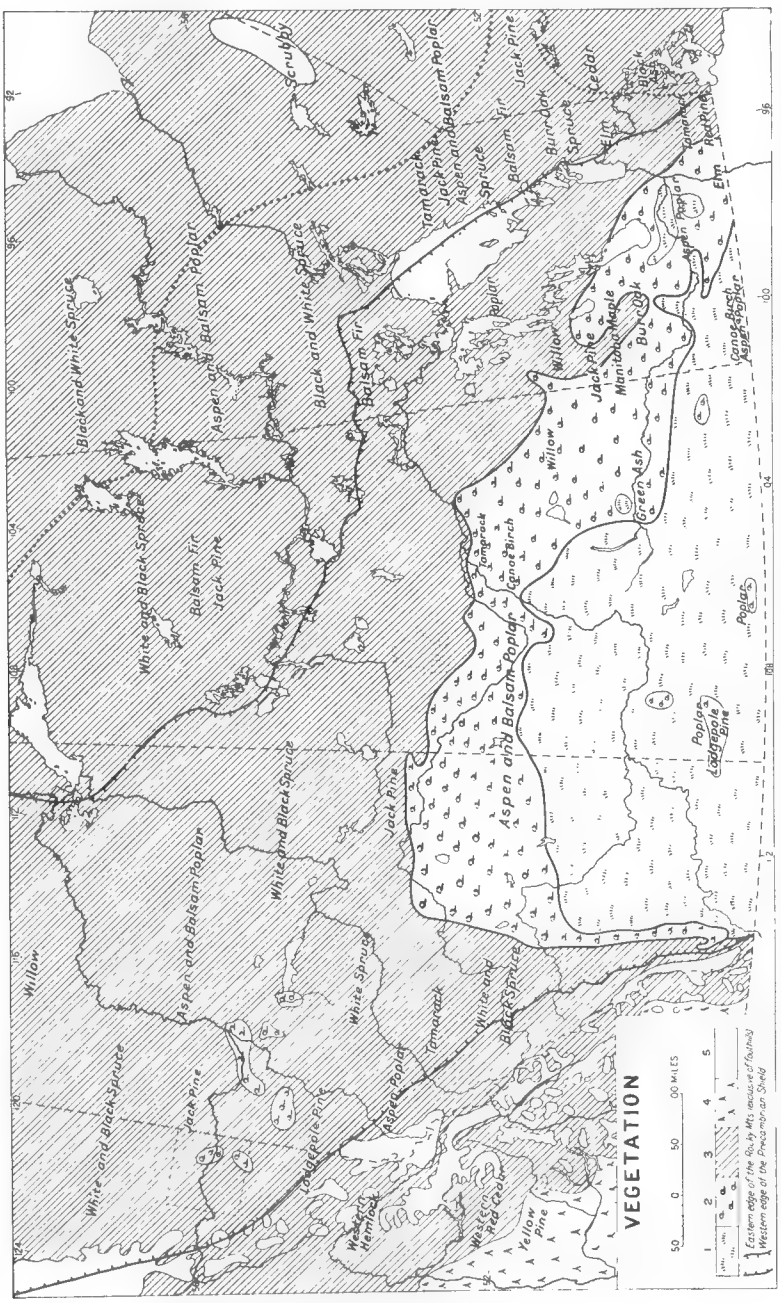


FIG. 23—Natural vegetation (based on published map by National Development Bureau, Department of the Interior, Ottawa). Key to numerals: 1, prairie vegetation (grassland), distinguished by short grass and almost devoid of trees, except fringes along some of the rivers and lakes; 2, park or grove belt; 3, northwestern coniferous forest, merged with sub-Arctic forest (northeast of the dotted line) and western coniferous forest; 4, semi-open coniferous forest; 5, treeless.

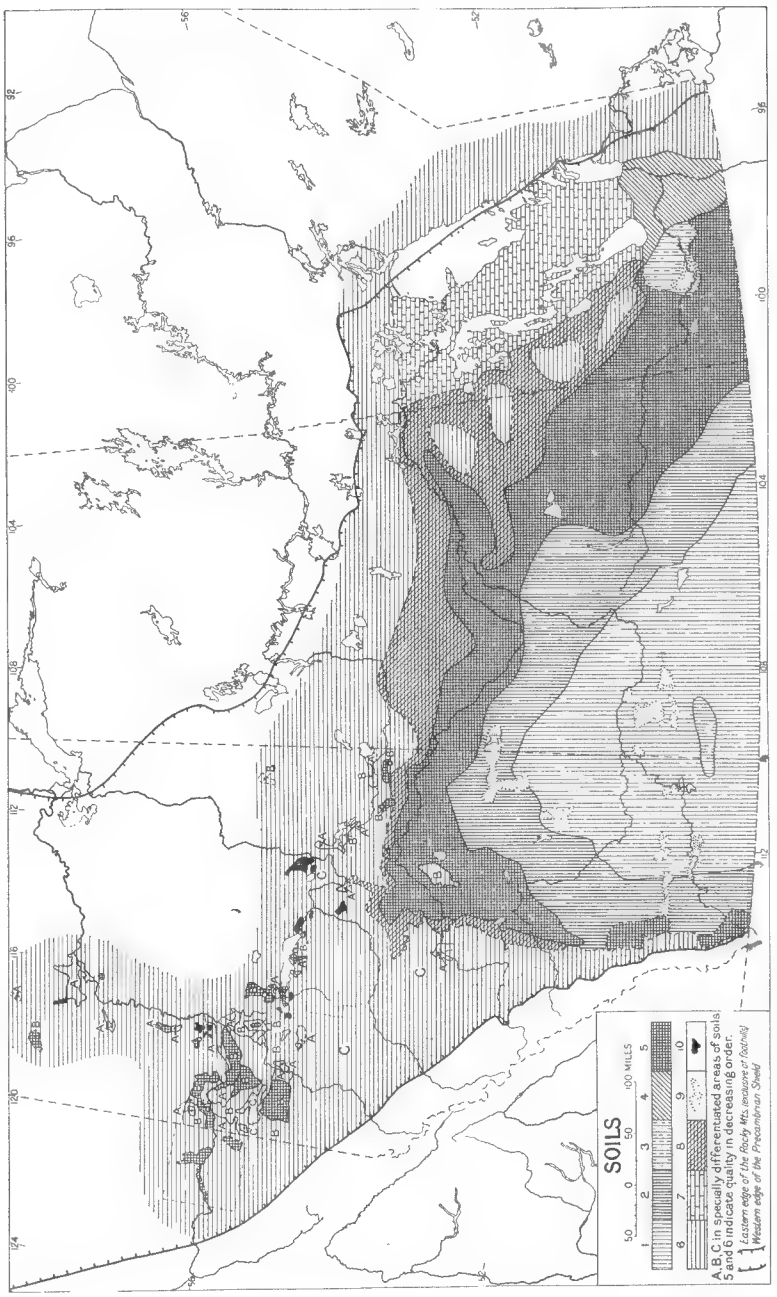


FIG. 24—Generalized soil map of the Prairie Provinces (prepared for the Canadian Pioneer Problems Committee by Dr. J. D. Newton, Department of Soils, University of Alberta). Key to numerals: 1, brown prairie soils; 2, dark brown prairie soils; 3, chestnut prairie soils; 4, black meadow soils ; 5, black park soils; 6, grey timber soils and peat; 7, grey timber soils and high lime peat; 8, transitional soils (grey timber and black park).

comparison with the black earth of the Red River Valley), but by their depth, ranging from 10 to 15 inches. These soils are among the most fertile of the whole region. As will be seen on the accompanying maps (Figs. 16, 23, 24), they are associated with an annual rainfall of about 15 inches or more, and with tall prairie grass.

The black meadow prairie soil of the Red River Valley is a continuation of the black-earth belt, extending north from the

FIG. 25—"Heavy bush" in the Alberta wooded belt (Alberta Soil Surveys).

Gulf of Mexico. The black surface soil, rich in plant food, ranges from 8 to 24 inches in depth.

The soils of the treeless prairie range from dark brown to greyish brown in colour as one moves toward the more arid regions. The nitrogen content, though large, is less than in the park soils. The layer of alkali accumulation lies near the surface, so near in some cases as to give rise to definitely alkali soils.

Over the whole grassland area the decaying roots of the grasses have added large quantities of humus to the soil, which have been chiefly responsible for its favourable mechanical properties. The whole region being one of light rainfall, the absence of continuous

moisture between the surface-soil and the ground-water level, or "water-table", prevents the leaching of the mineral salts. The freezing of the soil in the early winter prevents the decomposition of vegetable matter before spring, when decomposition coincides with the heavier rainfall and warm weather of the growing season.

The soil map shown here (Fig. 24) is highly generalized, and excludes the marked variations which occur within the general

Fig. 26—"Burned over" wooded area in Alberta (Alberta Soil Surveys).

soil belts. Since the region has been profoundly modified by glaciation, there is a great complexity of soils recording the previous existence of glacial lakes, old beaches, moraines, and glacial deposits ranging in fineness from boulders and gravel to clay.

The settler coming to the Canadian grasslands was confronted with many unfamiliar problems. He found a grassland area where clearing was unnecessary and where the soil was ready for the plough, or, if some clearing was necessary, it was not difficult. He encountered unfamiliar extremes of temperature and a niggardly rainfall. Unless he clung to the parkland or the edge of the forest, firewood, the traditional fuel of the settler, was scarce or only

procurable on some distant river bank. In some areas water was unattainable at ordinary depths. Frost in the north and drought in the south made crops precarious. Adequate transportation was lacking. He found himself in a strange land, a human unit in a great experiment in colonization. Unless he were one of the many settlers who came to the Canadian prairies from Minnesota, the Dakotas, or Oklahoma, his traditional knowledge was not suited

FIG. 27—Open muskegs characteristic of some wooded areas (Alberta Soil Surveys).

to grappling with the problems which confronted him. Could he find a livelihood and security? Could the resources of this new country support agricultural settlement, or should the country, as many a hard-pressed settler asked himself, be left to the buffalo and the fur trader? Much thought was given to these questions before the decision to colonize was reached. The questions continued to be asked long after settlement had been undertaken.

CHAPTER II

EXPLORING THE AGRICULTURAL POSSIBILITIES OF THE WEST

BY the middle of the nineteenth century circumstances focused the attention of the British and Canadian Governments on Rupert's Land, the territory of the Hudson's Bay Company. Discontent had been steadily growing in the settlements on the Red River. The measures taken by the Company to preserve its monopoly of the fur trade against the illicit trade of the settlers and of the United States "free-traders" at Pembina provoked a gathering storm of protest. Civil order was maintained with difficulty. In the United States, westward expansion was rapid. By 1850 the frontier of settlement had gone beyond the Missouri River, and population had reached a density of two to the square mile along a line running from Council Bluffs to Green Bay. In addition there was a small area with this density in Minnesota.[1] In 1850 the territory of Minnesota had a population of 6,000, exclusive of Indians. By 1860 there were 172,000 people in the state, of whom 1,600 were in Pembina County on the Canadian border.[2]

In the era of the fur trade, the Hudson Bay and the St. Lawrence routes competed for the trade of the western plains. Experience demonstrated the superiority of the Hudson Bay route and the York boats.[3] About the middle of the century increasing advantage began to be taken of steamboat navigation on the Mississippi. By 1844 regular trains of Red River carts from the Red River Settlement began to reach St. Paul. Six carts were reported in that year, 102 in 1851, 600 in 1858, and by 1869 the number reported was 2,500.

Steamboat navigation on the Red River began in 1859, and the Mississippi became the chief route of the Hudson's Bay Company.[4] The first railway from tidewater reached the Mississippi in 1854,

[1] *Statistical Atlas of the United States, 11th Census, 1890* (Washington, 1898), Plate 4.

[2] H. V. Robinson, *Early Economic Conditions and the Development of Agriculture in Minnesota* (Minneapolis: University of Minnesota Press, 1915), Appendix, Table XI.

[3] H A. Innis, *The History of the Fur Trade in Canada* (New Haven· Yale University Press, 1930) p. 163.

[4] Robinson, *op. cit.*, p. 32.

and others followed. Minnesota achieved its first railway in 1862.[5] Settlement was driving the fur trade across the United States prairie, and the Red River Settlement was finding its base of supplies more and more in St. Paul; a few years earlier, during the Oregon boundary dispute, the United States had elected a President on a cry of "Fifty-four forty or fight". It was to be expected, therefore, that the British and Canadian Governments should direct their attention to the question of the future of the prairies of British North America.

Early in the fifties Canada began to experience a period of expansion and prosperity based on high prices for wheat and lumber, access to the United States market, and an ambitious programme of railway construction. In 1856 the president of the Canadian Executive Council declared that the western boundary of Canada should be the Pacific Ocean, and the Toronto *Globe* reiterated a Canadian version of the doctrine of "manifest destiny."[6]

The British Government based its decision as to the future of the Hudson Bay territory on the report of the Select Committee of the House of Commons of 1857, and on the explorations of Captain John Palliser, who was instructed to report on the suitability of the country for settlement and the possibility of constructing a trans-continental railway. After the Committee had recommended cession to Canada, the Canadian Government sent out expeditions in 1857 and 1858 under S. J. Dawson and Professor Henry Youle Hind, to survey a road from Lake Superior to the Red River and to report on the possibilities of settlement.

The Select Committee on the Hudson's Bay Company heard the evidence of many witnesses and directed a part of its inquiries to the question of the suitability of the Company's territories for agricultural settlement. On the whole, the evidence of those who declared the country, in general, to be unsuited to agricultural settlement, appeared to be based on more extensive personal observation than the evidence of those who argued in favour of colonization. Most of the former, however, were not unbiased witnesses, as many of them were connected with the Company. Of these the most important was Sir George Simpson, the Governor of the Company.

Sir George Simpson was strongly of the opinion that no part

[5] Robinson, *Op. cit.*, pp. 35-6

[6] Chester Martin, "The Red River Settlement", *Canada and Its Provinces* (Toronto, 1914), Vol. 19, p. 60.

of the Hudson's Bay Company territories was suitable for settlement. While he considered the scarcity of fuel to be a handicap and the soil, except on the banks of the rivers, inferior, he laid greatest emphasis on the uncertainty of crops. The Red River district was not well adapted for settlement

> on account of the poverty of the soil, except on the banks of the river (the Red). The banks of the river are alluvial and produce very fair crops of wheat; but these crops are frequently destroyed by early frost; there is no certainty of the crops. We have been under the necessity of importing grain within these last ten years from the United States, and from Canada, for the support of the establishment [7]

Of the Saskatchewan country he said:

> the climate is more vigorous, and the crops are even less certain on that river: the scarcity of timber is also a great bar: there is little or no wood in the country. The present population of Red River have great difficulty in providing wood for their immediate wants.[8]

He later admitted that the importation of flour in 1847 was due to an unusual number of troops wintering at Red River rather than to crop failure, but contended that due to flooding, grasshoppers,[9] and early frosts, crops were very uncertain and frequently failed. The country could not provide the means of subsistence for a dense population.[10] He stated that the plains beyond the banks of the Red River had been tried and found to be poor.[11]

Sir John Richardson, the Arctic explorer, considered the prairie soils inferior to the alluvial soils, but laid greater emphasis on the lack of transportation.

> If, under the name of settlement, is meant the means of subsistence simply, I think that a considerable population might subsist as high as Peace River upon the alluvial points and the skirts of the prairie land, but if it is to be a productive or progressive colony, I think that there are no means and that there are not likely to be any means of producing a flourishing colony without some market or some conveyance for the grain: they would only raise enough to support themselves, but could not export grain without better roads than exist at present: a railroad from Canada, if such a thing could be constructed, might offer an outlet, but until the settlement of Canada has advanced close to the Red River, I do not think any wise settler would go beyond that place, there being so much better land nearer the market to be had at very moderate rate.[12]

Though witnesses connected with the Hudson's Bay Company

[7] Minutes of Evidence, Report of the Select Committee on the Hudson's Bay Company, *British Parliamentary Papers*, 1857, p 722.
[8] *Op. cit*, p. 723.
[9] *Op. cit*, pp. 804, 805
[10] *Op cit*., p 1426.
[11] *Op cit*, p 1796.
[12] *Op cit*, p. 2902.

were not without special interests in their condemnations of settlement, they had over those who disagreed with them the advantage of a fairly wide knowledge of the country. The proponents of settlement, on the whole, had little knowledge acquired at first hand, and were inclined to base their contentions on the progress of settlement in Minnesota, or to overstate their case grossly. William Kernaghan stated that "from common report" he knew that United States settlers were pressing close to the British boundary[13] and that it was "the talk of the country" that settlement and trade were hindered by the Hudson's Bay Company.[14]

Dr. Richard King, who had been with the Arctic expedition in search of Sir John Ross, stated that he had personal knowledge of a large tract "bounded on the south by Cumberland House on the Saskatchewan and by Athabaska Lake on the north" which was arable land and suitable for settlement.[15] This is an area into which agricultural settlement has scarcely penetrated in 1933. "The whole of the Great Fish River, down to the Polar Sea, is the finest grazing country in the world, as far as grazing is concerned: of course it is alluvial soil based upon sand and therefore not arable land."[16] Hon. William H. Draper, the representative of the Canadian Government, considered, from information given to him by others and from what he had read of the country, that it was fit for settlement and that only a policy of discouragement could have prevented an increase in settlement such as had taken place in Minnesota.[17]

In reporting, the Committee did not venture to decide on the suitability of the country for settlement, but recommended that, in view of the desire of Canada

> to annex to her territory such portions of the land in her neighbourhood as may be available to her for purposes of settlement

and, because of the interest of Canada in the maintenance of order, arrangements be made for the cession of the country to Canada.[18]

During the years 1857 to 1860, Captain John Palliser carried on explorations from Lake Superior to beyond the Rocky Mountains, under instructions from the Colonial Office

> to explore that portion of British North America which lies between the northern branch of the River Saskatchewan and the frontier of the United States and

[13] *Op. cit.*, p. 2246
[14] *Op. cit.*, p. 2236.
[15] *Op. cit.*, p. 5641.
[16] *Op cit.*, p 5664
[17] *Op. cit.*, pp. 4127-28
[18] *Op. cit.*, p iv.

between the Red River and the Rocky Mountains, and to record the physical features . . . , the nature of its soil, its capability for agriculture, the quantity and quality of its timber and any indications of coal or other minerals.[19]

The expedition was "to examine the present route of travel with a view to ascertain whether it could be either shortened or rendered less formidable by any reasonable outlay, and whether, if such an expenditure of capital were devoted to that object, there was any prospect of a result favourable to emigration or agriculture commensurate with the sacrifice."[20]

Captain Palliser was not led to advocate a line of communication from Canada to the Pacific exclusively in British territory. "The time has now forever gone by for effecting such an object, and the unfortunate choice of an astronomical boundary has completely isolated the central American possessions of Great Britain from Canada in the east, and has also almost debarred them from any eligible access from the Pacific coast on the west."[21] Incoming settlers were certain to follow the Great Lakes to the extremity of Lake Superior at Superior City and then cross overland 70 or 80 miles to the St. Paul-Red River road. If, as seemed certain, a railway were built from St. Paul to Pembina,

it would not be unreasonable then to entertain the prospect that the Imperial Government might feel justified in encouraging the extension of such a railway on the British side of the line to the northward and westward, through the southern portion of the fertile belt to the Rocky Mountains; at all events as soon as the country showed symptons of becoming sufficiently populated to warrant such an effort.[22]

Captain Palliser, as a result of his explorations, divided the country between the Laurentian Shield and the Rockies into two parts, the "fertile belt" and the semi-arid desert. The fertile belt was the wooded and park area, and the more or less arid "desert" was the treeless prairie, the "true prairie".

The existence of a general law regulating the distribution of the woods in this portion of the continent suggested itself to us during our first summer's explorations, and subsequent experience during the season of 1858-9 fully confirmed it.

The fertile savannahs and valuable woodlands of the Atlantic United States

[19] Journals, Detailed Reports, and Observations Relative to the Exploration by Captain John Palliser of That Portion of British North America Which in Latitude Lies Between the British Boundary Line and the Height of Land of the Northern or Frozen Ocean Respectively and in Longitude Between the Western Shore of Lake Superior and the Pacific Ocean, During the Years 1857, 1858, 1859 and 1860 *British Parliamentary Papers*, 1863, pp. 4-5.

[20] *Op cit*, p. 21.

[21] *Op cit*, p 16.

[22] *Op cit*, p. 17.

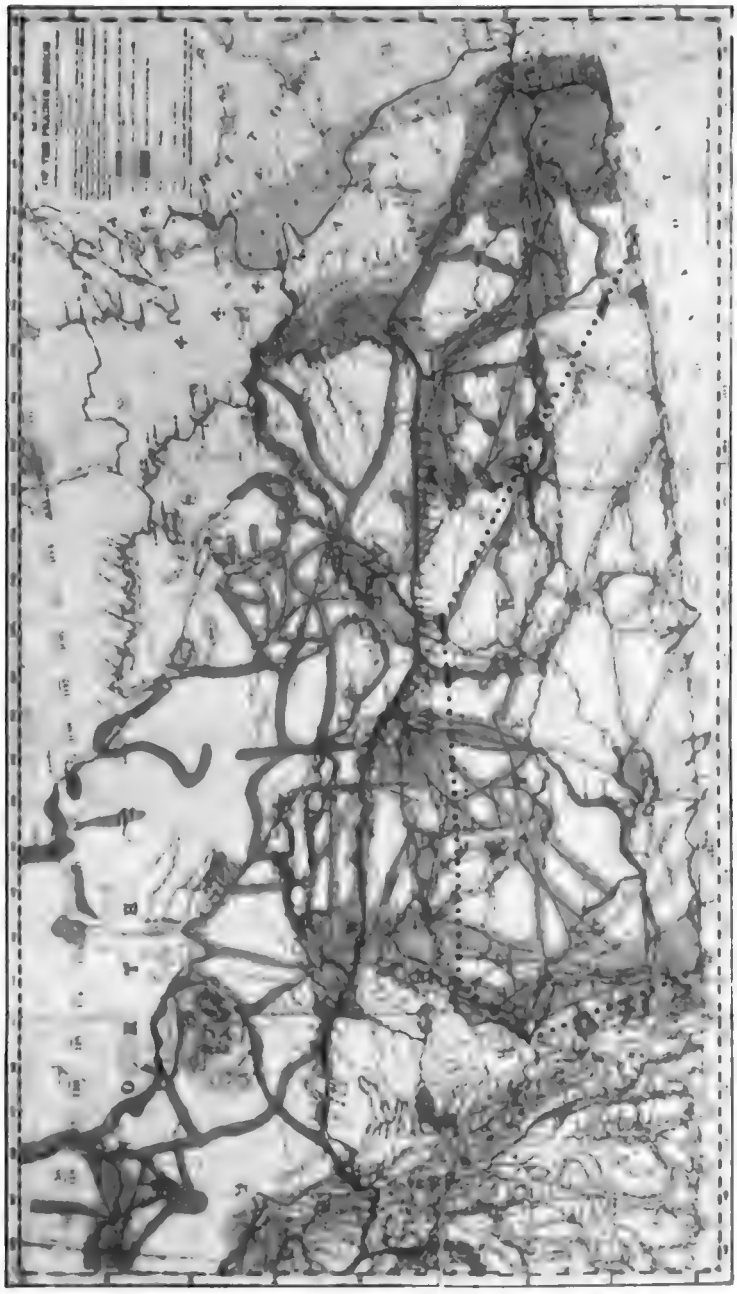


FIG. 28—Reproduction of the "Map of the Prairie Region . . . to distinguish the physical character of the country or the routes followed by different Explorers and Scientific Travellers" which accompanies the report for 1880 of the Engineer in [illegible]. The dark grey areas represent the belts of land along explored routes which were considered suitable for agriculture. The dark dotted line, which is not on the original map, has here been added to show "Palliser's triangle", —the area south of which line Palliser in 1860 considered infertile land.

are succeeded, as has been previously alluded to, on the west by a more or less arid desert, occupying a region on both sides of the Rocky Mountains, which presents a barrier to the continuous growth of settlements between the Mississippi Valley and the States on the Pacific coast. This central desert extends, however, but a short way into the British territory, forming a triangle having for its base the forty-ninth parallel from longitude 100° to 114°W., with its apex reaching to the fifty-second parallel of latitude. The northern forests, which in former times descended more nearly to the frontier of this central desert, have been greatly encroached upon and, as it were, pushed backwards to the north through the effect of frequent fires.

Thus a large portion of fertile country, denuded of timber, separates the arid region from the forest lands of the north, and the habit which the Indian tribes have of burning the vegetation has, in fact, gradually improved the country for the purpose of settlement by clearing off the heavy timber, to remove which is generally the first and most arduous labour of the colonist.[23]

"Palliser's triangle," when more minutely described, turns out to be an irregular pentagon (Fig. 28). Its broad base extends along the forty-ninth parallel from Turtle Mountain at 100° west longitude to the foot of the Rocky Mountains at 114°. From the latter point the boundary runs north-northwest to Old Bow Fort, about fifty miles west of Calgary, then north-northeast to a point just short of latitude 52° and longitude 114° in the vicinity of the present town of Olds, Alberta, thence almost due east along the fifty-second parallel to a point just south of Saskatoon, and from there southeast to the eastern limit of the base at Turtle Mountain.

This line marks the boundary of two natural divisions of the country, viz., the ancient forest lands and the true prairie district. To the north of this line generally there is timber, a good soil for agricultural purposes up to 54° north latitude, and superior pasturage; to the south there is no timber, the soil is sandy, with little or no admixture of earthy matter, and the pasture is inferior. Exceptions of course may be found, as for example in the neighbourhood of swamps and gullies, where the soil and pasture are better. The entire absence of wood on the prairie lands is felt by the Plain Indians during the severe months of winter. During the summer they use as fuel the bones and dung of the buffalo, but in the winter they are obliged to retreat to the borders of rivers where they can obtain wood.[24]

Generally speaking, the valleys of the Red, the Assiniboine, and the North Saskatchewan were suitable for settlement, while the upper valleys of the Souris and the South Saskatchewan were unfit. In Palliser's view the northern fertile belt possessed natural facilities for agricultural settlement. The lakes and rivers provided an abundance of fish, which would provide part of the food

[23] *Op cit*, p. 7. [24] *Op. cit.*, p. 89.

for the colonist while he was establishing himself. There was a good supply of rich pasture and natural hay sufficient to provide for cattle throughout the year. Sufficient areas had been cleared by fires that the settler might begin to cultivate his land immediately. There was ample timber for the construction of buildings, and wood and coal for fuel. Frost would be a serious factor only in the higher altitudes near the Rocky Mountains.[25]

Though he considered the country of the South Saskatchewan unsuited to settlement, lacking all the advantages of the fertile belt except freedom from forest growth, Palliser noted that it was less arid than areas in the United States in the same longitude. He was inclined to infer that great evaporation and the character of the soil had much to do with the aridity of this district.

> In the summer of 1859 the Expedition traversed the most arid plains that lie within the British territory without, however, encountering any of the great expanses of true desert country which exist further to the south, within the United States. Neither was there any marked difference between the frequency of rain clouds and the deposit of dew; and that a considerable amount of moisture passes over the plains is proved by the marked increases in the vigour of the vegetation on high patches of table-land such as the Hand Hills. Other parts of the prairie are covered with a short sparse growth of wire grass, which is very nutritious, but in very small quantities, along with the sage (artemisia) and cacti (opuntiae). There is no doubt that the prevalence of a hard clay soil derived from the cretaceous strata which bakes under the heat of the sun, has a great deal to do with the aridity of these plains, but it is probably due more to want of moisture in the early spring. The little snow which falls on the open plain is at once swept off by the winds and evaporation during the winter, so that in spring the clear powerful sun at once bakes the soil and prevents the germination of seeds.[26]

Palliser had at his disposal little in the way of meteorological information, and comparatively few records of agricultural experiments. His conclusions with regard to precipitation were necessarily derived almost entirely from vegetation. Some of his observations betray a lack of knowledge of agriculture. It is stated, for example, that agricultural operations in the Red River Settlement may usually be commenced by the end of May, and that the cereal harvest begins about the 10th of August—a growing season of 71 days![27] A botanist of his party, however, estimated that in the neighbourhood of Fort Carlton the harvest could be begun at the end of August or during the first week in September.[28]

[25] *Op. cit.*, p. 11.
[26] *Op. cit.*, Appendix 12, p. 270.
[27] *Op. cit.*, p 9.
[28] *Op. cit*, p. 250.

Wheat Palliser considered to be a precarious crop by reason of the frequent spring frosts (Sir George Simpson spoke of "early frost").[29] Cattle-raising should be the chief occupation of the settler because of the abundance of natural pasture and hay.[30]

In 1857, while Palliser was pursuing his explorations for the Government of Great Britain, the Canadian Government dispatched an expedition under the leadership of George Gladman, with S. J. Dawson as surveyor, Professor H. Y. Hind as geologist and naturalist, and W. H. Napier as engineer, specially commissioned to explore a possible route for a "good commissariat road between Lake Superior and the Red River district."[31] The expedition explored the route from Lake Superior to the valleys of the Red and of the Assiniboine as far west as Portage La Prairie. The report was enthusiastic about the possibilities of settlement, which it was thought, however, would be limited by the ancient beaches and ridges of Lake Agassiz.[32] The soil of the area is reported to be "eminently rich and fertile",[33] capable of producing 40 bushels to the acre when the land was first broken, and a good farmer could get 56 bushels.[34] The wheat, it is stated, matured in 105 days, while an imported Scotch wheat was ready for the sickle in 97 days.[35] The summer of 1855 was apparently an *unusually* wet summer, for the report states that 30 inches of rain fell during June, July, and August. From June, 1855, to May, 1856, a precipitation of 52.4 inches is recorded, and stated to be representative.[36] The thirty-year average used by the Dominion Meteorological Service as "normal" is 20.2 inches.[37] The greatest obstacle to colonization was found to be not in physical conditions but in the lack of a market. Farming was a whole-time occupation for but a few of the inhabitants, and, for the most part, it was carried on in a "slovenly" manner. There was no incentive to break more land or to produce greater crops, for there was no market for the surplus.

The report laid great emphasis on the contention that there remained in the United States no extensive "free soil" area suitable for settlement. A familiar passage is quoted from the article

[29] See above p. 29.

[30] *Op cit.*, p 9.

[31] *Report on the Exploration of the Country between Lake Superior and the Red River Settlement*, Printed by Order of the Legislative Assembly (Toronto 1858), pp. 5-16.

[32] *Op cit.*, pp 269 and 297.

[33] *Ibid.*

[34] *Op cit*, p. 321.

[35] *Op cit*, p. 312.

[36] *Op cit.*, p. 363.

[37] *Canada Year Book, 1926* (Ottawa Dominion Bureau of Statistics, 1927), p. 49.

on meteorology by Professor Joseph Henry in the *Patent Office Record* for 1856.

> We have stated that the entire region west of the 98th degree of west longitude, with the exception of a small portion of western Texas and the narrow border along the Pacific, is a country of comparatively little value to the agriculturist: . . . . This statement when fully appreciated will serve to dissipate som of the dreams which have been considered realities, as to the destiny of the western part of the North American continent.[38]

Extracts are quoted from Blodgett's *Climatology of the United States* published in 1857, to show that climatic conditions were favourable in the Northwest. The desirable area is

> a wedge-shaped tract, ten degrees of longitude in width at its base along the 47th parallel: inclined northwestward to conform to the bend of the Rocky Mountains, and terminating not far from the 60th parallel in a narrow line which still extends along the Mackenzie for three or four degrees of latitude in a climate barely tolerable . . . In every condition forming the basis of national wealth, the continental mass lying westward and northwestward from Lake Superior is far more valuable than the interior in lower latitudes, of which Salt Lake and Upper New Mexico are the prominent known districts.[39]

In 1858 a second expedition was sent out in two main parties. The first, under S. J. Dawson, was directed to continue the survey of a transportation route from Lake Superior to the Red River Settlement, and to explore the country west and north of the settlements. The second, under Professor H. Y. Hind, was commissioned to explore the country of the Assiniboine and the Saskatchewan.

S. J. Dawson reported that both the valley of the Souris River and the country between the lakes and the Manitoba Escarpment were suitable for settlement. He recommended a transportation route combining water transportation and a series of portage roads. The route comprised 367 miles of navigable water and 131 miles of land carriage.[40] The route afterwards became famous—or infamous—as "the Dawson Road".

Professor Hind limited his explorations to that part of the country which lay east of the north-and-south course of the South Branch of the Saskatchewan.[41] Generally speaking, he considered

[38] *Report on the Exploration of the Country between Lake Superior and the Red River Settlement*, p. 395.
[39] *Op. cit*, pp. 396-7.
[40] S. J. Dawson, Report on the Exploration of the Country between Lake Superior and the Red River, *Appendix to the Journals of the Legislative Assembly of Canada* (Toronto: 1859)
[41] References given below are to the official reports. See also H. Y. Hind, *Narrative of the Canadian Red River Exploring Expedition of 1857 and of the Assiniboine and Saskatchewan Exploring Expedition of 1858*, 2 vols. (London: 1860).

the treeless portions of the second prairie level as unsuited for agricultural settlement.

The boundary of the prairie country, properly so called, may be roughly shown by a line drawn from the great bend of the Little Souris, or Mouse River, to the Qu'Appelle Mission, and from the Mission to Moose Woods, on the South Branch, [i.e., from about longitude 101° on the international boundary to the South Saskatchewan at 52°30 north latitude]. South and west of this imaginary line, the country, as a whole, must be ranked as a level or slightly undulating treeless plain, with a light and sometimes drifting soil, occasionally blown into dunes, and not in its present condition fitted for the permanent habitation of civilized man.[42]

The term "wooded country" is applied to the Park Belt, which Hind, like Palliser, considered to be a region in which repeated fires had eradicated all but occasional patches of aspen. "This lamentable destruction of the forest is a great drawback to the country, and a serious obstacle to its future progress. It appears to be beyond human power to arrest the annual future conflagrations as long as the Indians hold so vast a prairie region as their hunting grounds."[43] Hind placed reliance on the article, quoted in his previous report, by Professor Joseph Henry of the Smithsonian Institution, stating that the entire area in the United States west of the 98th meridian was agriculturally useless, and also on the work of Lorin Blodgett, which stressed the greater amount of precipitation to be found in the valleys of the Red and the Saskatchewan than further south. So he concluded:

The arid region or Great Plain, west of the 101st degree of longitude, receives a very small amount of precipitation from the humid south winds coming up the valley of the Mississippi from the Gulf of Mexico. It is too far south to be much affected by the northeast winds or the westerly winds from the Pacific. This vast treeless prairie forms, in fact, the northern limit of the great arid region of the eastern flank of the Rocky Mountains; but still its humidity is greater than that of the plains south of the Missouri, in consequence of its high northern latitude.[44]

He exaggerated the aridity of the Far West on account of the extravagant notion he had acquired of the amount of the precipitation in the Red River Valley.

Forty-eight inches of rain and thirty-nine inches of snow were registered by Mr. Gunn near the Stone Fort, Red River, between June 1st, 1855 and May

[42] H. Y Hind, Preliminary Report on the Assiniboine-Saskatchewan Exploring Expedition, *Appendix to the Journals of the Legislative Assembly of Canada* (Toronto: 1859).

[43] H. Y. Hind, General Report on the Assiniboine-Saskatchewan Exploring Expedition, *Appendix to the Journals of the Legislative Assembly of Canada* (Toronto 1859), Chap. XV.

[44] *Op. cit*, Chap XV.

31st, 1856. The precipitation at Toronto during the same period was thirty inches of rain and seventy-two of snow, giving an excess of humidity to the climate of the Selkirk settlement, as compared with Toronto in that period, represented by fourteen inches, a quantity exceeding the annual precipitation over the greater portion of the eastern flank of the Rocky Mountains south of the great Missouri bend.[45]

Small wonder that Hind thought the rainfall of the Red River Valley adequate!

Projects to settle the whole of the plains east of the Rocky Mountains he considered wholly impracticable.

Other visionaries have converted the four hundred thousand square miles drained by the Saskatchewan into a region of unbounded fertility and inexhaustible resources. Whereas, a proper appreciation and use of facts will convince the most sanguine that the larger portion of this area is, in its present state, unfit for the permanent habitation of man both on account of climate, soil and absence of fuel.[46]

In short, the wooded regions, the Park Belt, and the tall-grass prairie with the wooded banks of its rivers provided the necessary bases for settlement. The black and dark brown soils were rich, as forest growth appeared to demonstrate, precipitation was adequate, water supplies were available, and fuel was within reach. The short-grass prairies had inadequate precipitation; their soils were inferior; water was scarce and fuel non-existent. Little or nothing is said about the frost in the northern areas, and little attention is given to the variability of climatic conditions.

The available area of good arable land is estimated to be as follows:

	Acres
Red River and the Assiniboine Prairies east of the Prairie Portage	1,500,000
Eastern water-shed of the Assiniboine and La Rivière Salée	3,500,000
Long Creek and the Forks of the Saskatchewan	600,000
Between Carrot River and the Main Saskatchewan	3,000,000
The Touchwood Hill Range, the Moose Woods, etc.	500,000
Mouse River, Qu'Appelle River, White Sand River	1,000,000
The region about the headwaters of the Assiniboine, including the valley of the Swan River	1,000,000
	11,000,000

An equal additional area is estimated to be suitable for grazing purposes.[47] In these areas alone, the Census of 1926 records 22,000,000 acres of improved land and 37,000,000 acres occupied.

[45] *Op. cit.*, Chap. XV.

[46] *Op. cit.*, Chap XV.

[47] H. Y. Hind, Preliminary Report on the Assiniboine-Saskatchewan Exploring Expedition, *Appendix to the Journals of the Legislative Assembly of Canada* (Toronto 1859).

The evidence given before the Select Committee of 1857 was extremely contradictory and not notably unbiased. Palliser and Hind, however, are strikingly in agreement in their general conclusions. Both eliminate "Palliser's Triangle" as unsuitable for settlement: both agree as to the fertility of the Park Belt and the adjacent wooded sections and as to the fitness of that area for settlement: they both saw the necessity for improved transportation: neither looked for rapid settlement.

The prospects depicted in these surveys created little enthusiasm in Great Britain, if one may judge from the *Edinburgh Review*. Concerning the proposal to take over the territories of the Hudson's Bay Company, a reviewer writes, "The truth is, a colony has already been established at the Red River. It has conspicuously failed from defects of climate, position and communication, and there is no reason to think that the failure would be less complete if the name of the Crown were substituted for that of the Company."[48] In comment on Palliser's and Hind's reports, a later article represents it to be a matter of congratulation that the inhabitable territory is so small that it is unlikely to involve Great Britain in any dispute with the United States.

> It would be an intolerable evil if so small and comparatively insignificant a portion of British soil as this "fertile belt" were to involve us in complications with our neighbours. With our examination of the whole midland region, much of this danger, it will be granted, disappears; for no one is likely to invade "strong woods" or a desert; while the existence of a large disaffected population, or, in fact, any large population at all, becomes highly improbable. . . . There is very little prospect of rapid settlement in the region between Canada and British Columbia.[49]

Rupert's Land became the Northwest Territory of Canada in 1870, and it was decided to construct a transcontinental railway wholly in Canadian territory. In spite of political changes and conflicts between the Liberal policy of government construction utilizing waterways, and the Conservative policy of subsidized private all-rail construction, work went on until its completion in 1885. In the preliminary surveys for the railway is to be found still another general estimate of the suitability of the western plains for agricultural settlement. An attempt was made to add, to the information acquired by the parties of the Engineer-in-Chief of the Canadian Pacific Railway, the reports made by earlier

[48] *Edinburgh Review*, CIX (1859), 79.
[49] *Edinburgh Review*, CXIX (1864), 243.

explorers, including those previously discussed here, and also those of Sir John Richardson, the British North American Boundary Commission, and the Dominion Land Surveyors. The accompanying map (Fig. 28), reproduced from the report of the Engineer-in-Chief for 1880, sets out in general form this compilation of information.[50] It will be seen that much of the "true prairie" land which Palliser rejected is here classified as arable.

Professor John Macoun, botanist to the Engineer-in-Chief, was responsible for the report on the greater part of the territory, and also summarized the results of other surveys. He took strong exceptions to some of Palliser's conclusions, particularly concerning the semi-arid belt. Palliser was inclined to conclude that what was treeless prairie was arid, even though the presence of large herds of buffalo indicated good grazing. Macoun concluded that apparent aridity was associated with the heavy cretaceous clays which baked in the sun and became impervious to rain. Once the soil was broken and cultivated the precipitation appeared to be ample.[51] Except for isolated patches of poor soils, Macoun eliminated the apex and also the plains of the Souris from Palliser's Triangle. Deducting 48,000 square miles for wet, arid, and bad lands, he estimated that between Manitoba and the Rockies there were 234,502 square miles, or 150,000,000 acres fit for agriculture and pasture.[52]

	Square Miles	Acres of Good Land
Total area north of latitude 51°, east of mountains and west of Manitoba, and as far north as good land is known to extend, exclusive of Peace River district..	160,442	
Deduct for bad and wet lands.	23,000	87,963,000
Peace River District as far as explored, Dr. Dawson's estimate..	31,550	
Deduct for wet lands, lands known to be bad, and estimated quantity to be bad in unexplored parts. .	6,000	16,352,000
Total area north of boundary and south of latitude 51° and between Manitoba and the Rocky Mountains..	90,510	
Deduct for sandy or arid land.....	19,000	45,766,000
Total area of land fit for agriculture and pasture. ..		150,081,000

Macoun allowed only 20,000 square miles for the "arid" country of Palliser's Triangle. A great enthusiast for the colonization of

[50] "Reports and Documents in Reference to the Canadian Pacific Railway, Sandford Fleming, Engineer-in-Chief," *Sessional Papers of Canada*, No. 123 (Ottawa. 1880).

[51] John Macoun, General Remarks on the Land, Wood, and Water of the North West Territories from the 102nd to the 115th Meridian and between the 51st and 53rd Parallels of Latitude (*op. cit.*, Appendix 14), pp. 238-239.

[52] *Op. cit.*, p. 245.

the prairies, he doubtless overestimated the area of arable land. The Census of 1926 reported in this whole area only 89,000,000 acres of occupied land, of which only 49,000,000 acres were improved.[53]

Macoun was one of the first to appreciate fully the significance of the northward sweep of the summer isotherms in the region of the Canadian West and of the large proportion of annual precipitation falling in the warm season. The statements in Blodgett's *Climatology* were confirmed by the records of newly established meteorological stations and by his own study of the flora of the region. He concluded "that as there was but one flora common to the region extending from eight to twelve degrees of latitude, or as far north as 60°, and as that flora required a high summer temperature for its existence, the thermometer would be found to show a corresponding distribution of heat throughout the whole district".[54] He also confirmed Blodgett's statement that "the spring opens at nearly the same time along the immense line of Plains from St. Paul to Mackenzie River"[55].

Macoun pointed out that the seasonal distribution of rainfall and not the annual amount was the significant factor for agriculture. He noted that, for the four summer months, rainfall at Winnipeg exceeded that at Toronto, while for the fall months Winnipeg precipitation was only 10 per cent. of that at Toronto. He argued that the moisture carried by prevailing winds northwestward from the Gulf of Mexico is not deposited further south because of the warm air rising from the Great American Desert, but is carried on to the Canadian Northwest. This effect of the American Desert is absent in winter, and hence the moisture does not reach the Canadian Plains.[56] Macoun also had an analysis made of Red River soil and noted the unusually high nitrogen, potash, and lime content.[57]

On these conclusions and on the results obtained by some of the early settlers, he based his estimates of the capabilities of the Canadian West as a region for agricultural settlement.

In 1904 the report of Professor James Mavor to the British Board of Trade on the Northwest of Canada made public three

[53] *Canada Year Book, 1929*, p 272.
[54] John Macoun, *Manitoba and the Great Northwest* (Guelph, Ontario· 1882), p. 143.
[55] *Ibid*, p. 152
[56] *Ibid.*, pp 149-150.
[57] *Ibid.*, p 202.

independent estimates of the amount of agricultural land and of the probable export surplus of wheat.[58]

The first estimate classified 92,000,000 acres of land as suitable for settlement and cultivation. Of this 13,750,000 acres might be devoted to wheat, producing 254,000,000 bushels, of which two-thirds (169,000,000 bushels) would be available for export (Fig.29).

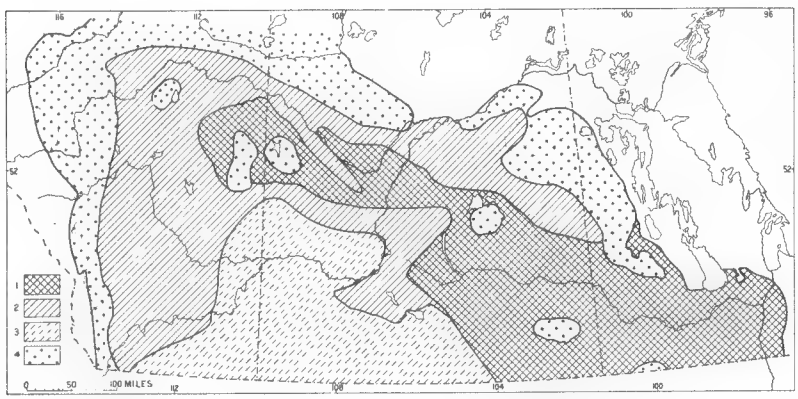


FIG. 29—Map of the Northwest of Canada showing approximate areas of land relatively susceptible of wheat growing (based on map by Professor James Mavor in the report cited in footnote 58). Key to numerals: 1, area in which wheat is a certain crop; 2, areas in which wheat is a less certain crop and in which mixed farming is more likely to be profitable than exclusive wheat growing; 3, areas suitable for pasturage although wheat may be grown to some extent; 4, areas not suitable for wheat cultivation: at present timbered and largely suitable only for pasturage even when cleared.

In the second estimate, 101,000,000 acres were considered suitable for settlement, of which 22,000,000 might be sown annually to wheat, producing a crop of 357,000,000 bushels. (The Census of 1926 reported 90,000,000 acres in farms, 22,000,000 acres in wheat, and a product of 381,000,000 bushels.) The third estimate, made by Dr. Charles Saunders, the originator of Marquis wheat, was much more optimistic or visualized a much more distant future. Out of a total area of 232,000,000 acres he considered 171,000,000 acres suitable for settlement and capable of producing 812,000,000 bushels of wheat—a total never yet reached in the history of the Prairie Provinces.

Dr. D. A. MacGibbon, of the Board of Grain Commissioners,

[58] Report to the British Board of Trade on the Northwest of Canada, *British Parliamentary Papers*, 1904, Cd. 2628: Appendix A, with map (here reproduced as Fig. 29).

has recently estimated the probable maximum production of wheat in Western Canada as 700,000,000 bushels.[59]

These then are the more important surveys and prognostications which were available to those charged with determining and executing the policies of agricultural settlement. The records of the past sixty years show the extent to which the situation had been properly analysed.

[59] "Future Export Trade in Wheat", *Contributions to Canadian Economics* (Toronto: University of Toronto Press, 1932), V, 28.

CHAPTER III

RAILWAYS AND SETTLEMENT

"IT is only in the simple society that life in the modern world can be maintained acceptably at great distances from the railway."[1] The birch canoe, the York boat, the Red River cart, and the river steamer were efficient enough means of getting the furs of the Canadian plains to the seaboard, but they were utterly inadequate to bridge the gap between the grower of wheat and his European market. Only with modern railways and cheap ocean transport can the frontier produce bulky staples, such as wheat, for metropolitan markets, and, without markets, the pioneer fringe is condemned to a low and rude standard of living, a precarious existence in which man, unarmed, pits his strength against relentless nature.

"There are not likely," said Sir John Richardson before the Select Committee on the Hudson's Bay Company, "to be any means of producing a flourishing colony without some market or conveyance for the grain."[2] He referred particularly to a railway to the sea or to navigable water, but his statement applies equally to the need for a railway net linking the whole interior into one system of communication. The economic relation of the colony to the mother-country is essentially the same as that of the pioneer fringe to the mature centres of population. Without efficient transport between the centre and the circumference, economic life can be maintained only on a low, as it were a unicellular plane: there cannot exist that specialization, that differentiation of function which characterizes the higher forms of life, economically as biologically.

Callendar set out this most revealing of generalizations concerning the economic life of colonies.

> The most important feature of economic life in a colony or newly settled community is its commercial connection with the rest of the world. Upon this more than on any other circumstance depends its prosperity. It may be true, as a great rule, that "the colony of a civilized country which takes possession of the waste country or one so thinly inhabited that the natives easily give

[1] Isaiah Bowman, *The Pioneer Fringe* (New York American Geographical Society, Special Publication No. 13 1931), p. 66.

[2] See above, Chap. II, footnote 12.

place to the new settlers, advances more rapidly in wealth and greatness than any other human society" (ADAM SMITH). But this progress does not take place unless the colony possesses markets where it can dispose of its staple products. The history of modern colonization does not show a single case where a newly settled country has enjoyed any considerable economic prosperity, or made notable social progress, without a flourishing commerce with other communities. This dominance of foreign commerce in economic affairs may be considered the most characteristic feature of colonial economy.[3]

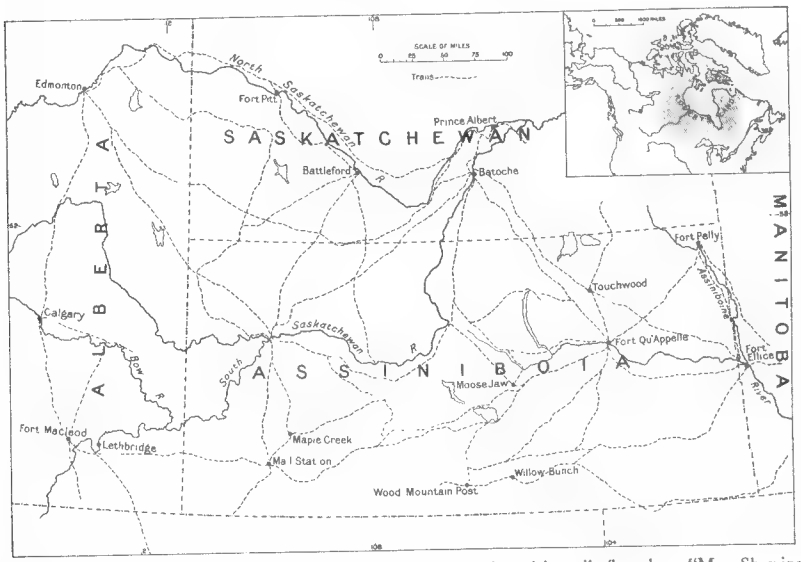


FIG. 30—Rupert's Land (in inset) and Northwest Territories with trails (based on "Map Showing Mounted Police Stations and Patrols Throughout the Northwest Territories During the Year 1886" *Sessional Papers of the Dominion of Canada, 1887*).

Like the colony, the pioneer fringe must achieve an export staple or revert to a lower material civilization based on primitive industry diversified only in accordance with the consumption-needs of the community.

For the grasslands of the great interior plains of North America the only staples capable of supporting a considerable population were agricultural products—livestock and grain. The large markets for these staples were far distant. The standard of living of such agricultural communities and their capacity to expand depended on the quantity of the products of mature communities which could be commanded by the prices received for agricultural exports

[3] G. S. Callendar, *Economic History of the United States* (Boston: 1909), p. 6.

in the markets of the world. Transportation costs were a deduction from income and an addition to expenditure.

In pre-railway days settlement in Western Canada was associated with waterways and with transshipment points, where sparse and desultory agricultural settlements surrounded important trading posts like Fort Edmonton and Prince Albert. These settlements produced no export surplus and depended entirely on the local market. In effect the settlements could export only so much produce as could be converted into furs and exported in that form. Only when improved transportaton would permit the export of grain or livestock was a flourishing colony possible.

Railways and continually improving transportation were as essential as rain and sun to progressive settlement on the Canadian prairie. Nearness to railways and to projected railways was of first importance to the settler. Small wonder that the demand for railways, more railways, and lowered costs of transportation was loud and continuous from the beginning of settlement down to the present.

In 1878 the first railway reached Winnipeg. It connected the Red River Settlement with St. Paul and Chicago. By 1883 the Canadian Pacific Railway stretched north of the Great Lakes to link Winnipeg with eastern Canada. In 1885 the first transcontinental line was completed from coast to coast.[4]

The second transcontinental railway system began in 1896 with the acquisition by two bold contractors, Mackenzie and Mann, of the Lake Manitoba Railway and Canal Company, which possessed a charter to build a line between Portage la Prairie and Lakes Manitoba and Winnipegosis. This company, transformed into the Canadian Northern Railway Company, acquired the Canadian lines of the Northern Pacific, and by 1902 had extended a railway from Winnipeg to Port Arthur. Thereafter lines were extended east and west. In 1911, the Dominion Government guaranteed bonds of the company to finance the construction of

[4] On the history of Canadian railways see.

O. D. Skelton, "The Railway Builders", *Chronicles of Canada* (Toronto: 1916).

S. J. McLean, "National Highways Overland", *Canada and Its Provinces* (Toronto: 1914)

H. A. Innis, *History of the Canadian Pacific Railway* (Toronto: 1923).

D A. MacGibbon, *Railway Rates and the Canadian Railway Commission* (Boston 1917).

W. T. Jackman, *Economics of Transportation* (Toronto: University of Toronto Press, 1926).

Report of the Royal Commission of Inquiry into Transportation, *Sessional Papers of Canada*, No 20g (Ottawa: 1917).

N. Thompson and J. H. Edgar, *Canadian Railway Development from the Earliest Times* (Toronto 1933).

the section from Port Arthur to Montreal, and to complete the road through the Rocky Mountains to Vancouver. In the meantime the company had completed many branch lines in the West and had acquired a number of small lines in the East.

As the Canadian Pacific Railway extended its lines in the East, the Grand Trunk Railway, whose main line from Portland, Maine, through Montreal and Toronto to Chicago had been completed in 1860, laid plans for extension into Western Canada. In 1903 an agreement was reached between the Dominion Government and the Grand Trunk Railway by which an additional transcontinental line was to be built jointly. The road was to be built in two sections. The eastern section from Moncton, N.B., to Winnipeg, called the National Transcontinental line, was to be built by the Dominion Government and leased for fifty years to the Grand Trunk Pacific, a subsidiary of the Grand Trunk. The western section, the Grand Trunk Pacific, was to be built by the company, from Winnipeg to Prince Rupert via the Yellowhead Pass, with the aid of Dominion bond guarantees.

During the World War, the National Transcontinental, the Grand Trunk Pacific, the Grand Trunk, and the Canadian Northern were taken over by the Dominion Government, and subsequently brought together in the Canadian National Railways. In 1931, railway service was opened on the government-constructed Hudson Bay Railway, between the prairie and Churchill on Hudson Bay.

The relation between railways and settlement is set out in the accompanying series of ten maps (Figs. 31-40) showing the settled areas and the railway lines in operation in the provinces of Manitoba, Saskatchewan, and Alberta at intervals since 1886. On the first two maps of the series, population is shown by dots distributed within the census areas according to the best historical information available. On Figure 33 only the railway lines existing in 1896 are shown, as the data for population distribution for that year are not available. On each of the remaining seven maps, the settled area is outlined from the township population figures of the census of that year. In some cases small settlements which are not separately recorded lie beyond the surveyed area. These are, however, never large, as the surveyors preceded settlement in Canada and the "squatter" was never a serious problem.

Before the coming of the railway, population clustered about the important trading posts; beyond the boundaries of Manitoba

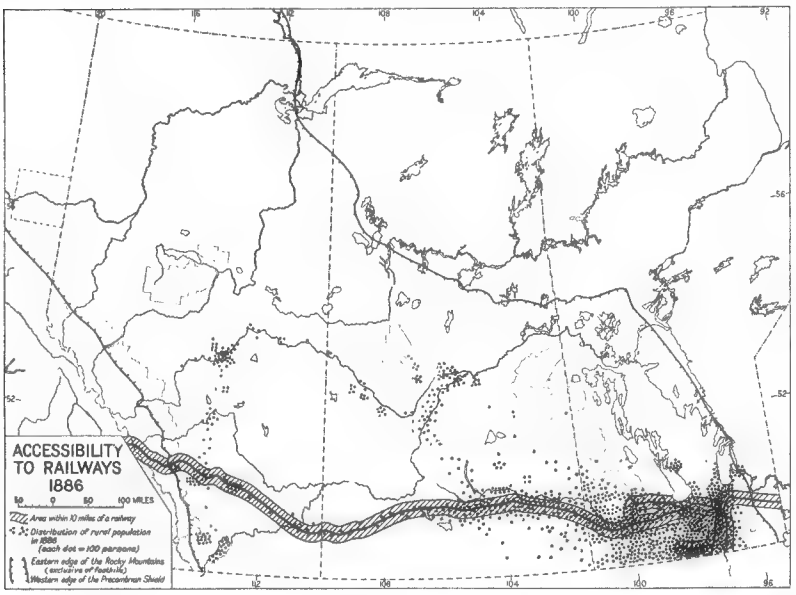


FIG. 1

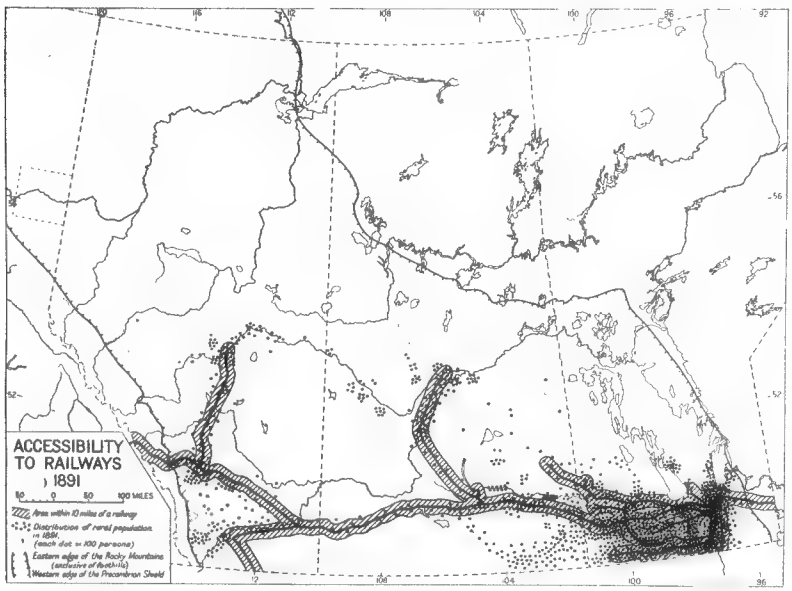


FIG. 32

FIGS. 31-40—A series of ten maps showing the relation of railways to the distribution of the rural population in the Prairie Provinces from 1891 to 1931. Accessibility is indicated by means of bands 20 miles wide enveloping the railway lines, 10 miles from a railway representing an economic limit (see text below, p. 55). For explanation of these and other symbols, see the legends on the maps. For sources on which the maps are based, see caption under Fig. 34.

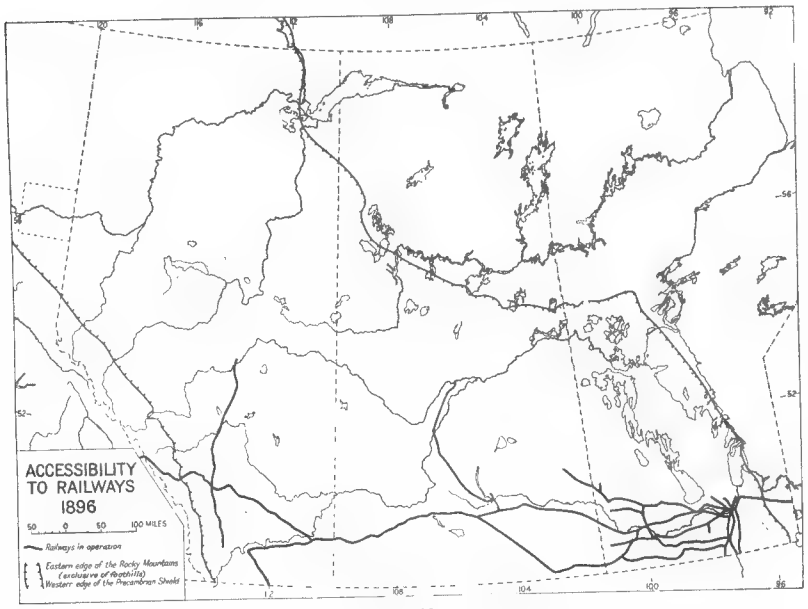


FIG. 33

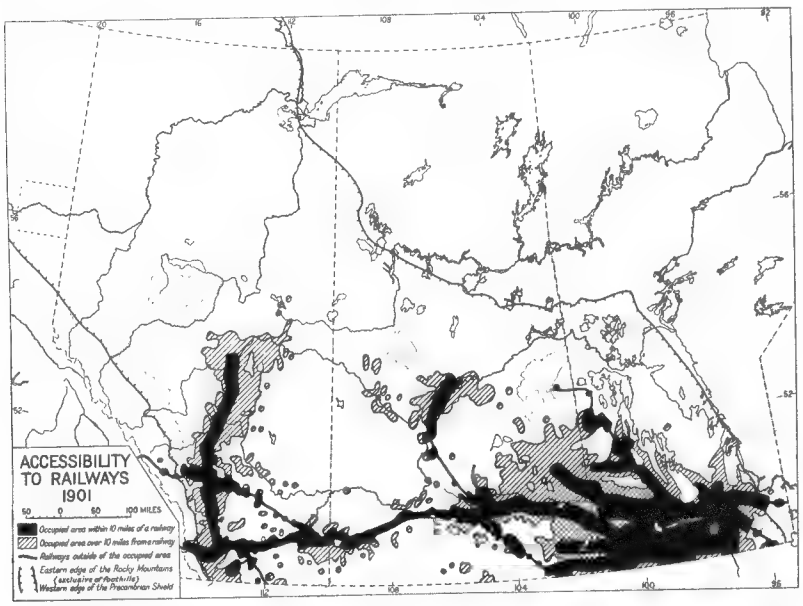


FIG. 34

On Figures 31-40 the year indicated in each map refers to June for the census on which the population distribution is based, and to December of the preceding year for the extent of the railway net. Railways are based on manuscript maps provided by the National Development Bureau, Ottawa; population is based on the quinquennial census published by the Dominion Bureau of Statistics, Ottawa. The settled area, shown from 1901 on (Fig. 34), is outlined from the township population figures of the census.

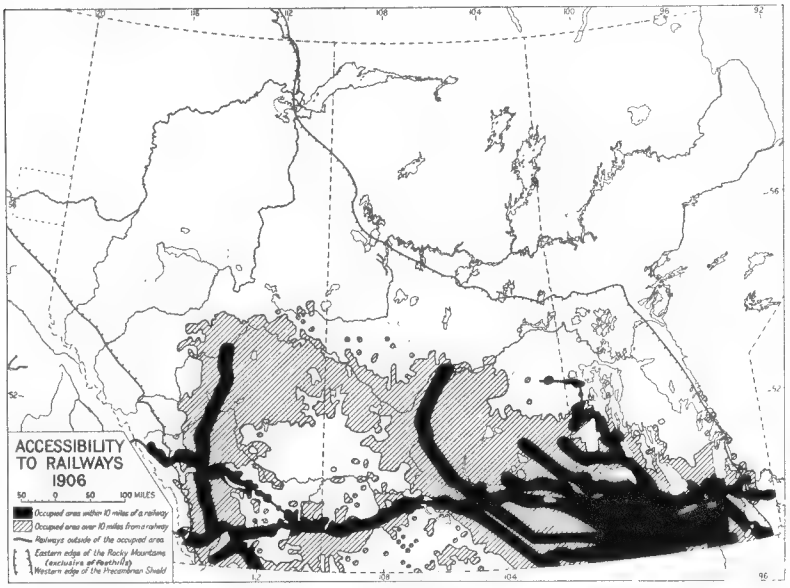

ACCESSIBILITY
TO RAILWAYS
1906
50 0 50 100 MILES
Occupied area within 10 miles of a railway
Occupied area over 10 miles from a railway
Railways outside of the occupied area
Eastern edge of the Rocky Mountains (exclusive of foothills)
Western edge of the Precambrian Shield

FIG. 35

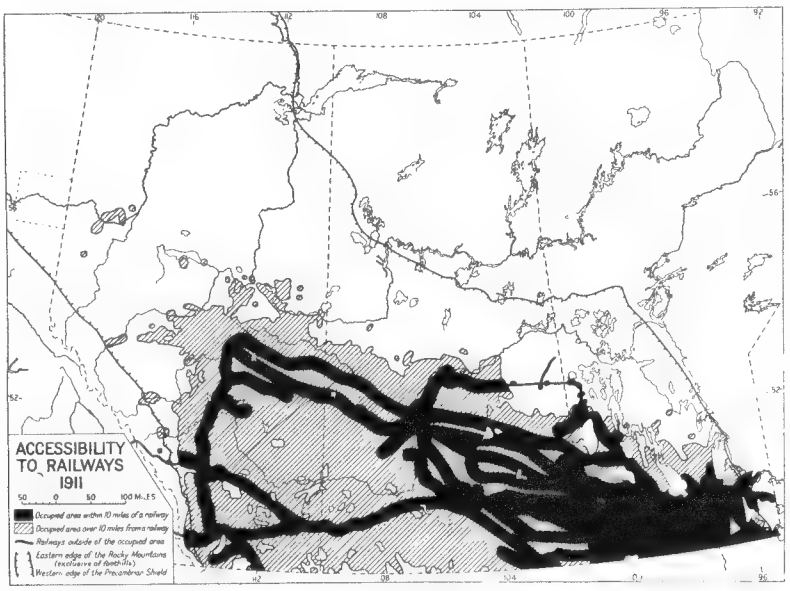

ACCESSIBILITY
TO RAILWAYS
1911
50 0 50 100 MILES
Occupied area within 10 miles of a railway
Occupied area over 10 miles from a railway
Railways outside of the occupied area
Eastern edge of the Rocky Mountains (exclusive of foothills)
Western edge of the Precambrian Shield

FIG. 36

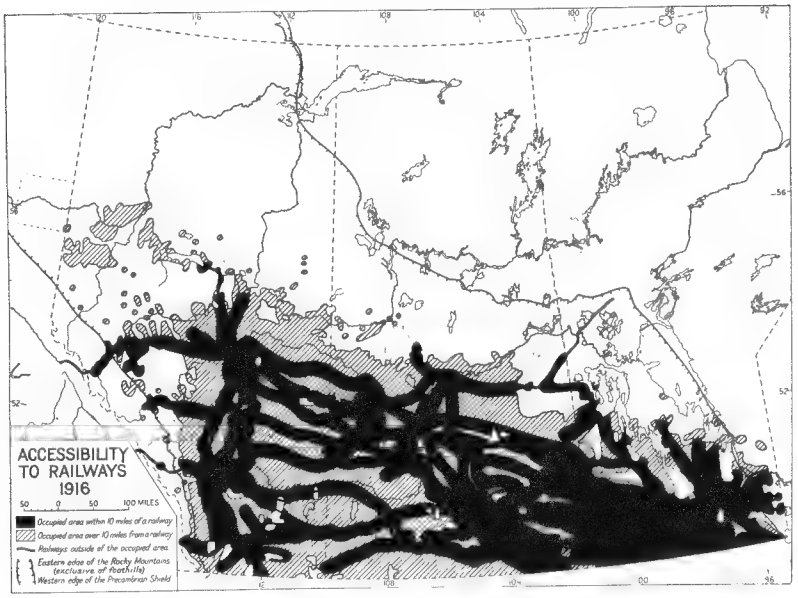

ACCESSIBILITY
TO RAILWAYS
1916
50 0 50 100 MILES
Occupied area within 10 miles of a railway
Occupied area over 10 miles from a railway
Railways outside of the occupied area
Eastern edge of the Rocky Mountains (exclusive of Foothills)
Western edge of the Precambrian Shield

FIG. 37

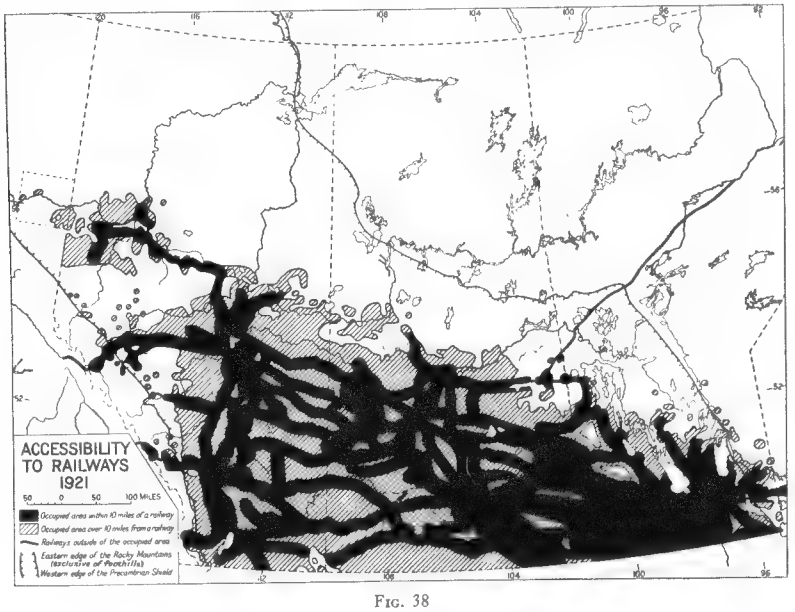

ACCESSIBILITY
TO RAILWAYS
1921
50 0 50 100 MILES
Occupied area within 10 miles of a railway
Occupied area over 10 miles from a railway
Railways outside of the occupied area
Eastern edge of the Rocky Mountains (exclusive of Foothills)
Western edge of the Precambrian Shield

FIG. 38

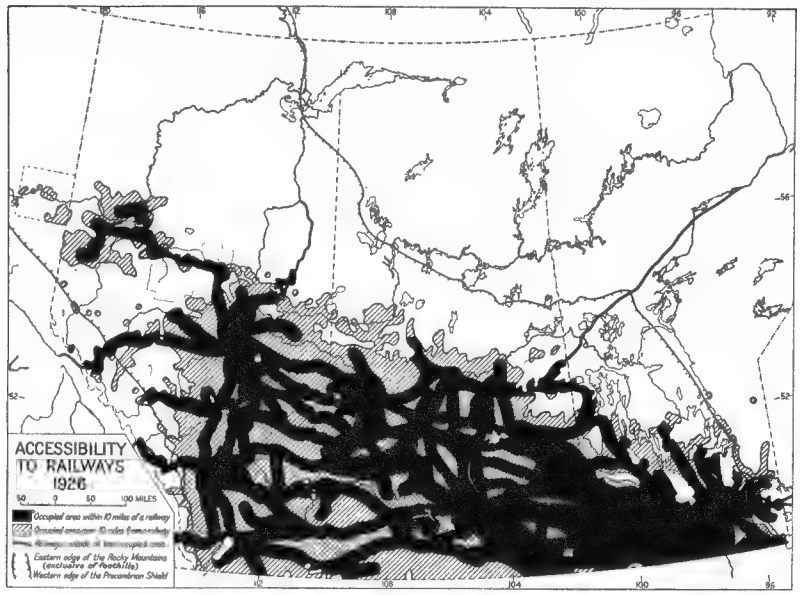

ACCESSIBILITY
TO RAILWAYS
1926
50 0 50 100 MILES
Occupied area within 10 miles of a railway
Occupied area over 10 miles from a railway
Railways outside of the occupied area
Eastern edge of the Rocky Mountains (exclusive of foothills)
Western edge of the Precambrian Shield

FIG. 39

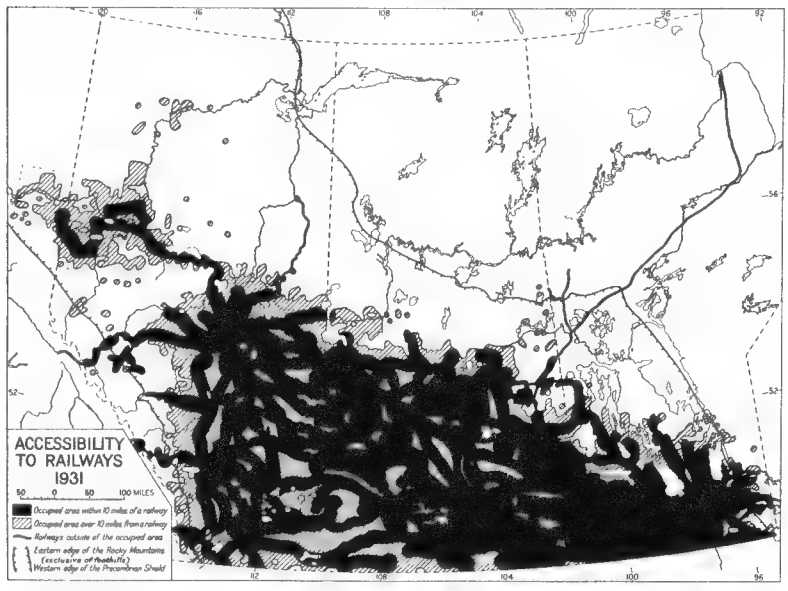

ACCESSIBILITY
TO RAILWAYS
1931
50 0 50 100 MILES
Occupied area within 10 miles of a railway
Occupied area over 10 miles from a railway
Railways outside of the occupied area
Eastern edge of the Rocky Mountains (exclusive of foothills)
Western edge of the Precambrian Shield

FIG. 40

considerable settlements of half-breeds existed at Edmonton, Prince Albert, and Battleford. In Manitoba, a substantial increase in settlement anticipated the railway; between 1871 and 1881, population (including Indians) increased from 73,000 to 122,000. Throughout the whole region new population followed the railway or located along the projected lines of railway. It will be noted on the maps how often a band of settlements appears five years before the railway is constructed. The railway was not built to reach the population; people settled where it was said a railway would be built, or perchance where it was already being built.

By 1901 (Fig. 34; for location of places, see Fig. 1) a considerable network of railways had spread over Manitoba. Only a small part of the settled portion of the province was more than ten miles from a railway. In the area comprising the present provinces of Saskatchewan and Alberta the main line of the Canadian Pacific Railway was in operation, together with the Crow's Nest Branch and the "Soo Line" connecting Moose Jaw with St. Paul. In addition, branch lines extended from Regina to Prince Albert, and from Calgary to Edmonton and to Macleod. The largest area distant more than ten miles from the railway was in eastern Saskatchewan. The settlement here was thin and anticipated railway construction. It was in this area that the greatest recent increases in population had occurred.

During the next five years, railway construction was most active in eastern Saskatchewan; important lines were pushed out from Yorkton and Fleming toward Saskatoon, and from Souris to Regina (Fig. 35). It was in this period that population swept across the "fertile belt", and the railways failed to keep pace. Much the greater part of the settled area in Saskatchewan and Alberta was more than ten miles from the railway, and grain was frequently hauled from 30 to 50 miles to a station or siding. The size of the area beyond the railway zone is an index of the rapidity of settlement, not of the unimportance of railways. Such settlements would never have been undertaken except in the hope that the railway would follow. In some cases the road was under construction; in some, the survey had been made; in others there was merely the hope that such good land must soon attract a railway.

The map for 1911 (Fig. 36) reveals how much of the movement of population into the Park Belt had been stimulated by the

projection of the Canadian Northern and Grand Trunk Pacific lines across this area. The construction of these railways, the building of further branch lines in Manitoba and eastern Saskatchewan, and the opening of a Canadian Northern line from Prince Albert through the Carrot River valley to Hudson Bay Junction were the important developments from 1906 to 1911. At the latter date, the large settled areas remote from railways were in western Saskatchewan and in Alberta. The rapid advance of population into the semi-arid country had left railway construction behind once more.

The next five years saw a multiplication of branch lines in eastern Saskatchewan and in Manitoba (Fig. 37). Many lines, also, were built across the semi-arid belt. Whereas in 1911 only three lines crossed the Saskatchewan-Alberta boundary, seven lines crossed it in 1916, and many intervening branches had been built. Railways had once more followed population, and population had settled in anticipation of railways. The number and extent of the areas from which grain had to be hauled long distances to the railways had been reduced greatly.

Railway construction came almost to a standstill during the period of the World War (Fig. 38). In spite of a considerable extension of settlement to the north and a marked increase in the area of cultivated land, the railway map for 1921 shows comparatively little change.

Between 1921 and 1926 (Fig. 39)[5], a period of low wheat prices and general contraction in western agriculture, some branch-line extension took place in the north, and the area of territory more than ten miles from railway transportation was further reduced. Reference to the map for 1931 (Fig. 40), however, shows that the period 1926-31 was one of much greater construction activity. By 1931 there remained, except on the outer fringe, only comparatively few areas beyond the ten-mile railway limit. These areas include forest reserves, Indian Reservations, "bad lands", and some thinly settled areas in the semi-arid belt. Railways over the whole of the West have been built up to the ten-mile limit. Areas lying beyond that limit, if of any considerable size,

[5] An earlier representation of railway accessibility at about this date is afforded by the Map of the Prairie Provinces on the scale of 35 miles to the inch prepared in 1922 by the Natural Resources Intelligence Service, Department of the Interior, Ottawa, showing on a background of land in each township available for homestead entry and land privately owned and unoccupied the belts 5, 10 and 15 miles from a railway. Possibly the manner in which these belts are coloured on the map is intended to imply that 5 miles is the critical economic distance.

are areas of expanding settlement for which rail provision has not yet been made, or areas with a low density of population, less than five to the square mile, with part of the area of a density of less than two to the square mile.

From this series of maps it appears that the railways, so vital to the settlement of the western plains, followed the settler rather than preceded him. In reality the settler, for the most part, merely anticipated the railway already projected or under construction. This was true of the trunk lines. The settler could be reasonably sure that branch lines would be built if the new community could offer sufficient traffic.

The maps support the empirical conclusion that it is economical for railways to bring virtually all productive areas in the Prairie Provinces within ten miles of their lines. The maximum hauling distance within the twenty-mile belt, if stations and sidings are seven to ten miles apart, is twelve to fifteen miles, depending on the direction and location of the roads. Under the stress of competition, railways may, of course, build more branch lines than are economically desirable. Independent evidence, however, suggests that it is not profitable for farmers to haul grain more than ten to fifteen miles. Bowman refers to a study made by the Kansas City Southern Railroad, in the pre-motor era, from which it was learned that while traffic was derived from a belt thirty miles wide, the significant freight was drawn from a belt ten miles wide.[6] The general conclusion of studies made by the Canadian National Railways in projecting branch lines is "that while, in exceptional circumstances, grain may be hauled distances up to fifty miles, the practical limit is in the vicinity of ten miles."[7]

It is difficult to arrive directly at any conclusion as to the distance beyond which hauling of grain is unprofitable. The cost to the farmer depends on the alternative uses to which his time and equipment might be put. As will be shown in later chapters, however, areas lying more than ten miles from the railway have low population density and are not characteristically grain-shipping districts.

The use of the truck may extend the belt adequately served by the railway somewhat. This, however, depends likewise on the alternative uses to which labour and equipment might be turned. If plenty of grain is available, railways are eager to build up to the ten-mile limit.

[6] Bowman, *The Pioneer Fringe*, p. 70.

[7] Letter of S. W. Fayerweather, Bureau of Economics, Canadian National Railways.

From the point of view of the farmer, the railway close at hand is always desirable. The freight rate is little, if any, increased, while the wagon haul is cut down substantially. In a district in southwestern Saskatchewan in 1911 farmers hauled grain 40 to 45 miles to Morse. A few years later a new branch was built, and grain was hauled 18 to 20 miles to Gravelbourg. At present it is hauled less than 10 miles to Bateman or St. Boswells. The rates on wheat to Fort William from all these places are the same, 13.2 cents per bushel. In northern Saskatchewan the rate from North Battleford is 13.8 cents; that from St. Walburg, 100 miles further north, is 14.4 cents. Railway rates on the Northern Alberta Railway serving the Peace River Country are the same as those from the Edmonton district.

In the early days of settlement grain was often drawn upwards of 50 miles to the railway. The value of the settler's time was small, and the importance of the cash income was very great. Before 1900 grain was hauled to Indian Head and Sintaluta from distances 25 to 30 miles north, across the deep gorge of the Qu'Appelle valley. Before 1910, when settlement had preceded the railways into the "dry belt", many settlers hauled wheat 50 miles and more to the nearest elevator. In pre-railway days settlers in the Peace River Country made annual pilgrimages to Edmonton, 300 to 400 miles, with horses or oxen, bringing a little grain or other produce for sale. The extension in 1930 of the Northern Alberta Railway into the Peace River Block of British Columbia ended a 50-mile grain haul to Spirit River for the settlers at Pouce Coupé. The grain is now shipped at Pouce Coupé, the rate being 18 cents as compared with a rate of 15.6 cents a bushel at Spirit River. Settlers at Fort St. John hauled their grain to the Peace River, where it was bagged and shipped by steamer 150 miles to the railway at Peace River Crossing at a cost of 25 cents a bushel. From Peace River Crossing to Vancouver it paid a rate of 15.6 cents. Settlers at Notikewin in the valley of the lower Peace in 1929 paid 25 cents a bushel for the trucking of grain more than 50 miles to the railway at Grimshaw. Little wheat is grown under these circumstances, however. Specialized wheat-growing areas develop only near the railway. The wheat grown far from the railway will be sufficient to meet only the most pressing needs for cash. Wherever possible grain is converted into livestock, a more valuable product, better able to stand the cost of transport. In the south, cattle, and in the north, where the cost of carrying

cattle through the winter is great, hogs are means of condensing field crops to transportable bulk. A settler far north in Saskatchewan more than 100 miles from a railway is said to have met his difficult transportation problem by growing potatoes and other vegetables, which he traded with his less agriculturally inclined neighbours, the Indians, for furs, which in turn he shipped out to the nearest market.

The inhabitant of the Prairie Provinces, like the inhabitant of other inland plains, is peculiarly dependent on railways. His agricultural system depends on railway communication. With the exception of a few of the older towns, the towns and villages are mere points on railways. Where the railway passed a village by, the whole village, buildings as well as people, has frequently been moved across the prairie to the railway. The railway with its unfailing accompaniments, the loading platform, the two to five grain elevators, the post-office, general store, machinery shed, and branch bank, closes the circuit through which the power of the world's economic organization flows into the pioneer community. What the birch canoe was to the fur trader, the railway is to the farmer of Western Canada. Beyond the end of steel there is only such settlement as waits month by month or year by year for the coming of the railway.

CHAPTER IV

THE SPREAD OF SETTLEMENT

DURING the sixty years in which the Canadian Northwest has been a part of Canada, its population has increased from 73,000 to 2,354,000. The years from 1870 to 1900 were years of small beginnings and of a false start. Only after 1900 did circumstances conspire to promote rapid settlement. The course of agricultural settlement is shown in the following table of acreage of occupied and improved land (see also Figs. 41 and 42).

TABLE II—OCCUPIED AND IMPROVED LAND IN THE PRESENT TERRITORY OF MANITOBA, SASKATCHEWAN, AND ALBERTA*

YEAR	OCCUPIED LAND (acres)	INCREASES SINCE PREVIOUS CENSUS (p c)	IMPROVED LAND (acres)	PERCENTAGE OF IMPROVED TO OCCUPIED LAND	IMPROVED LAND PER CAPITA
1831	..	.	2,152	.	1
1835	..		3,504	.	1
1840	..		4,041	..	1
1846	... ..	.	5,380		1
1849	.....	. .	6,392	.	1
1856	. .. ..	. .	8,806	..	1
1881	2,698,000	. .	279,000	10	2
1891	8,138,000	202	1,429,000	18	6
1901	15,512,000	91	5,593,000	36	13
1911	57,512,000	272	22,970,000	40	17
1921	87,932,000	53	44,863,000	51	23
1926	88,930,000	1	49,265,000	55	24
1931†	109,778,000	23	59,854,000	55	25
Northwest Territories Only: Excluding Manitoba.					
1881	314,000	.	29,000	9	5
1885	3,862,000	1,130	198,000	5	..

* Compiled from Census of Canada, 1870-71, and each census year following.
† Figures for 1931 are preliminary.

The pattern in which settlement spreads over a new land is affected by many factors. Settlers are neither more nor less rational than other humans. With such knowledge as they have,

they select good land. Their knowledge is often scanty and much of it hearsay. Frequently their knowledge of soils is inapplicable to the new country. Settlement attracts settlement, and the location of a few people in a district brings others in their train, even though the desirable land may have been already occupied. Individual preferences and prejudices, quite irrational, frequently account for an early bias in the pattern. Thus early settlers in Western Canada shunned the open prairie, clinging to the woodland and river bottoms, until the Mennonite colony in Manitoba led the way and established itself on the "high plains".[1] Over longer periods, however, the pattern of population yields to the persistent pressure of the physical world, if, in the meantime, there have not already been discovered methods of turning handicaps to advantages.

On the series of maps reproduced in this chapter (Figs. 43-49) the distribution of rural population, as reported in the Census, in the three Prairie Provinces and in the contiguous Peace River Block of British Columbia, is shown.[2] Population in 1886 and 1891 has been shown by dots on maps included in the preceding chapter (Figs. 31 and 32). The census divisions used in these censuses were so large as to render calculations of density meaningless. In these earlier maps the Indian population is included. The remaining maps in this series (Figs. 43 to 49) show the density of rural population. The territorial unit is the township (36 square miles), and hence the distribution of population is shown in great detail and with a high degree of accuracy. The limits of settlement are shown, with the exception of a few "islands" of population in the unsurveyed or unorganized parts. At no time since 1900 have these been of great importance.

The maps show also the fringe of settlement in which the rural population is less than two to the square mile. At times it is a fringe being rapidly converted into a denser, mature settlement; at other times it is a sort of permanent fringe, which, though settled long ago, has still only a "pioneer" density of population.

Agricultural settlement, as pointed out in the preceding chapter, followed the railways on which it was dependent. By 1901 (Fig. 43) incoming population had pretty well blocked out the valleys of the Red, the Assiniboine, the Souris, and the Qu'Appelle.

[1] J. W. Dafoe, "Economic History of the Prairie Provinces", *Canada and Its Provinces* (Toronto, 1914), Vol. 20, p. 295.

[2] The population of incorporated villages, towns, and cities, and of Indian Reserves is excluded.

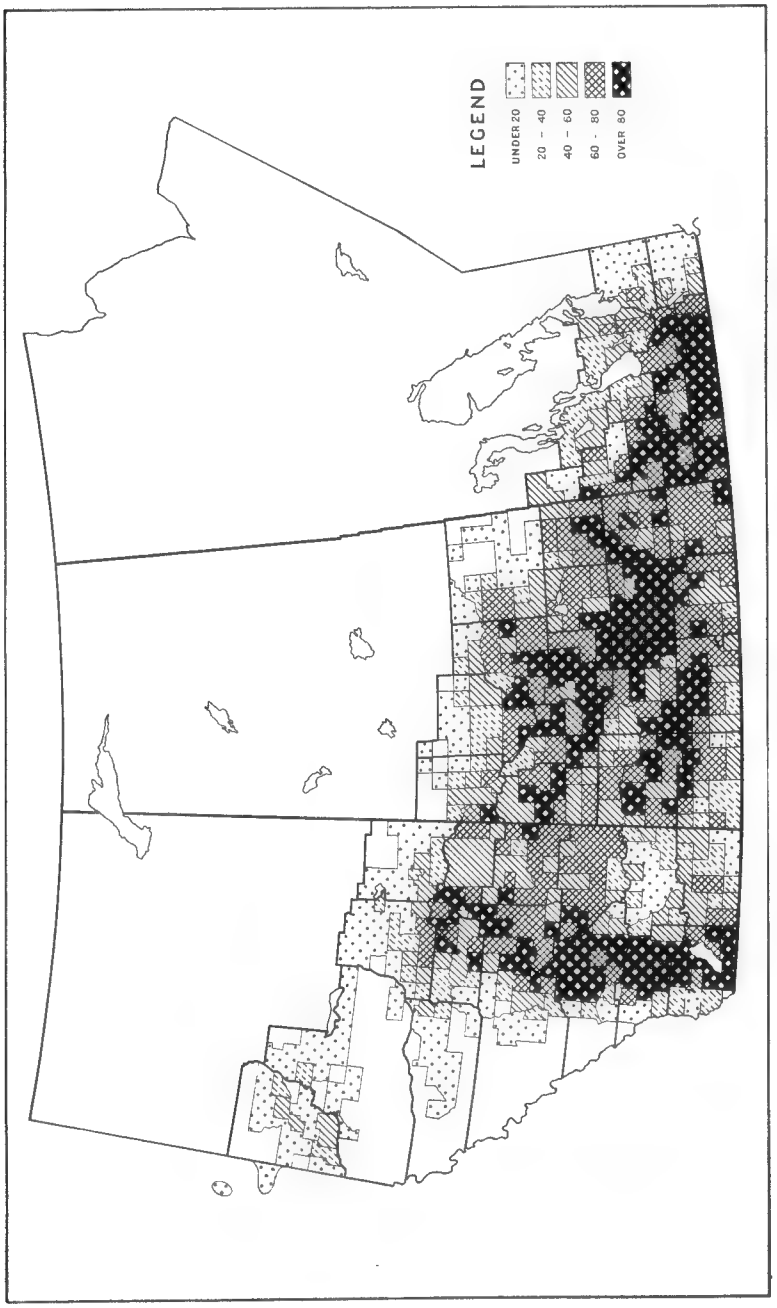


FIG. 41—Percentage of land occupied in the Prairie Provinces, 1926 (based on the census of 1926). The territorial unit is the municipality.

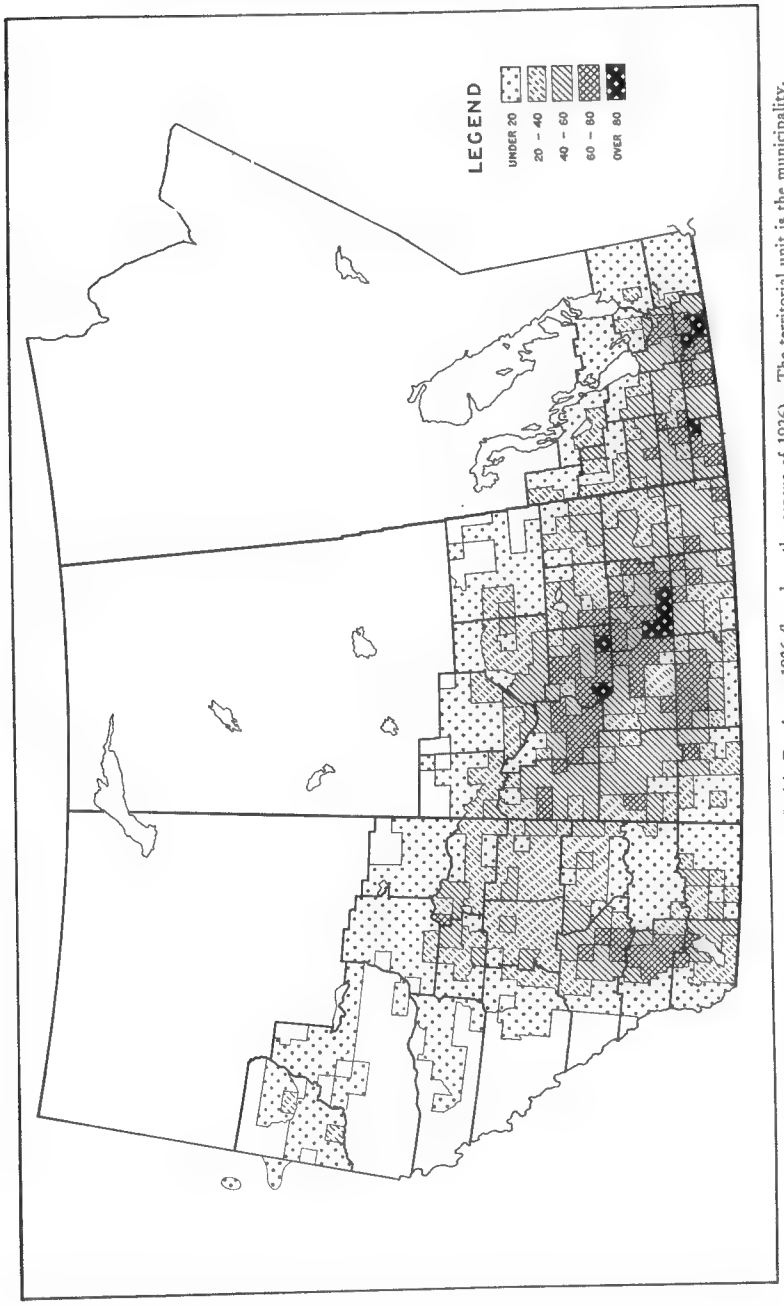


FIG. 42—Percentage of total land improved in the Prairie Provinces, 1926 (based on the census of 1926). The territorial unit is the municipality.

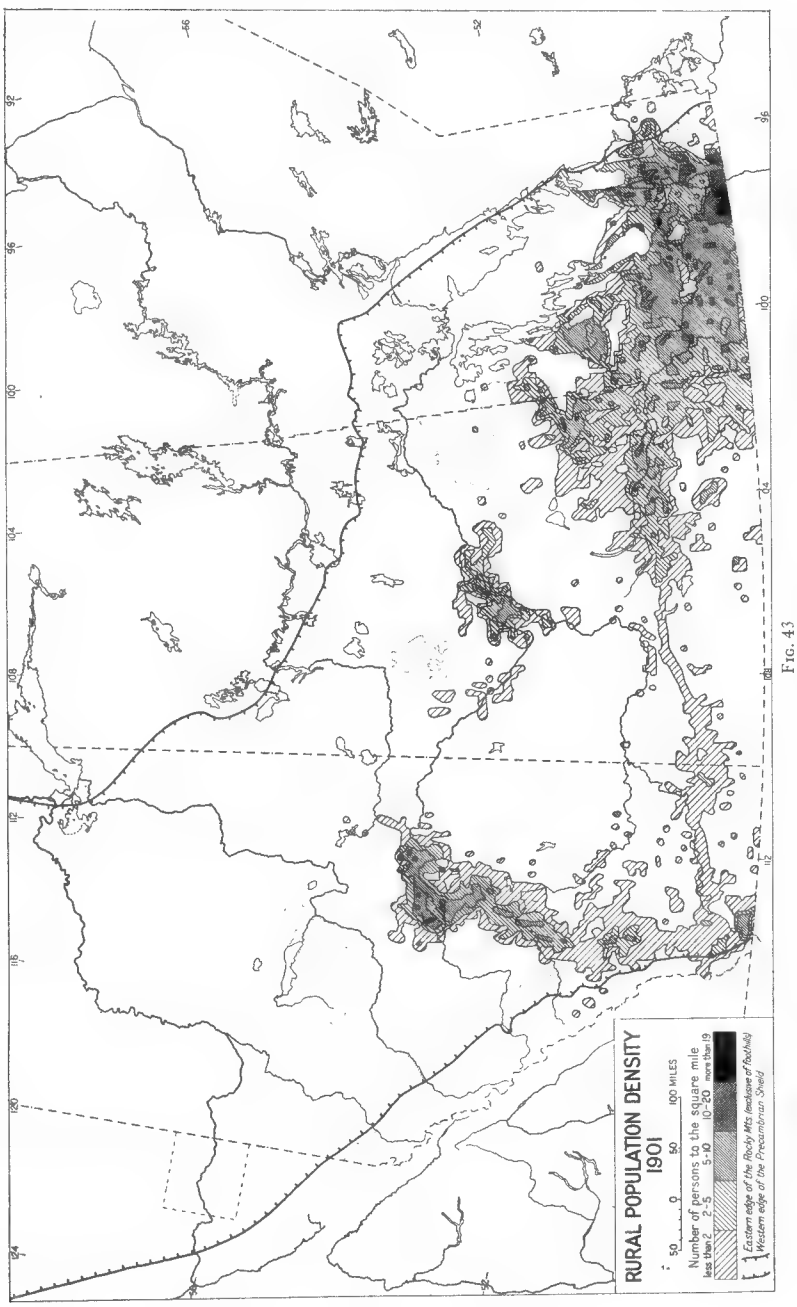


FIG. 43

FIGS. 43-49.—Rural population density of the Prairie Provinces at five-year intervals, 1901-1931 (based on the township population figures of the censuses of those years). In the maps of this series the population of Indian reserves, organized villages, towns, and cities, and of isolated settlements in unorganized territory is not included; the area of the townships is based on data in the Census of Canada for 1911. In cases where the areas were not given they were calculated from the "Sectional Maps" of the Topographical Survey of Canada.

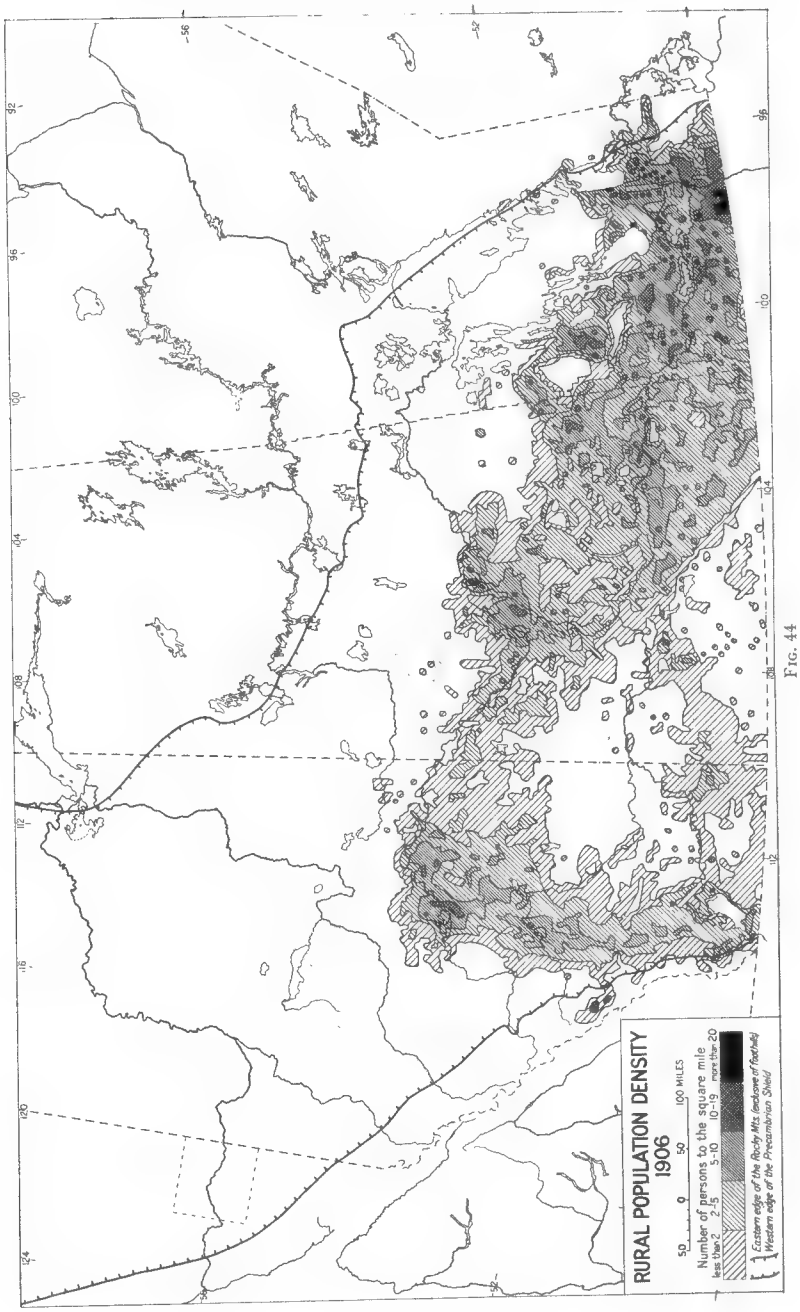

RURAL POPULATION DENSITY
1906
50 0 50 100 MILES
Number of persons to the square mile
less than 2 2-5 5-10 10-15 more than 20
Eastern edge of the Rocky Mts (exclusive of foothills)
Western edge of the Precambrian Shield

FIG. 44

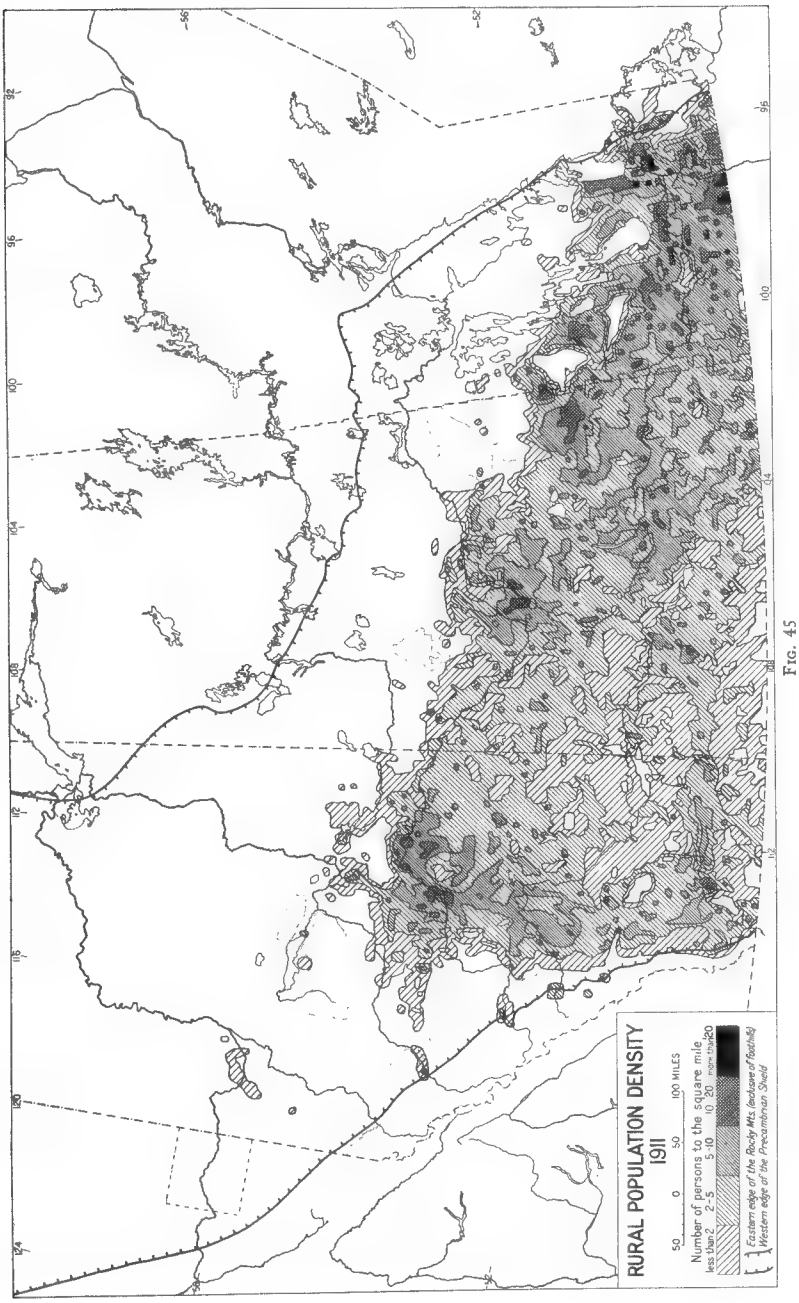

RURAL POPULATION DENSITY
1911
50 0 50 100 MILES
Number of persons to the square mile
less than 2
2-5
5-10
10-20
more than 20
Eastern edge of the Rocky Mts. (exclusive of foothills)
Western edge of the Precambrian Shield

FIG. 45

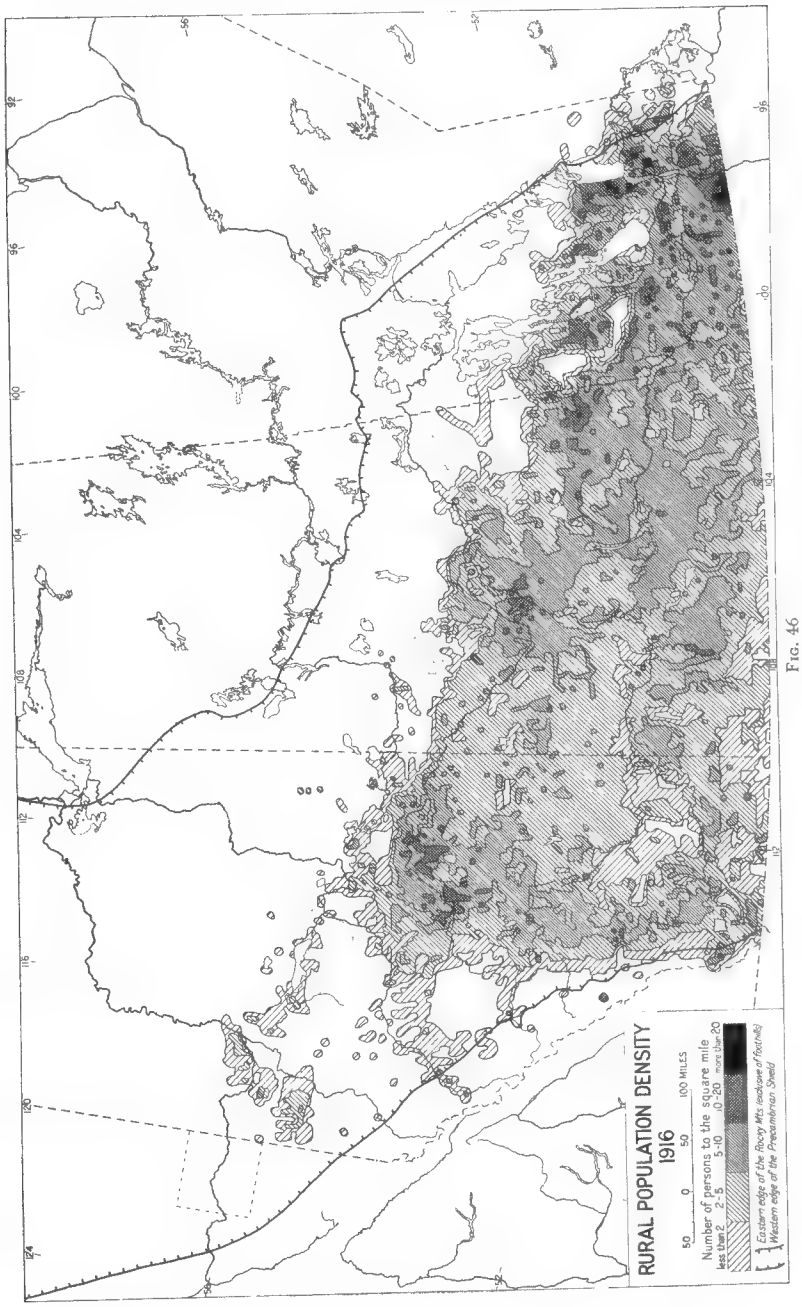

RURAL POPULATION DENSITY
1916
50 0 50 100 MILES
Number of persons to the square mile
less than 2
2-5
5-10
10-20
more than 20
Eastern edge of the Rocky Mts (exclusive of foothills)
Western edge of the Precambrian Shield

FIG. 46

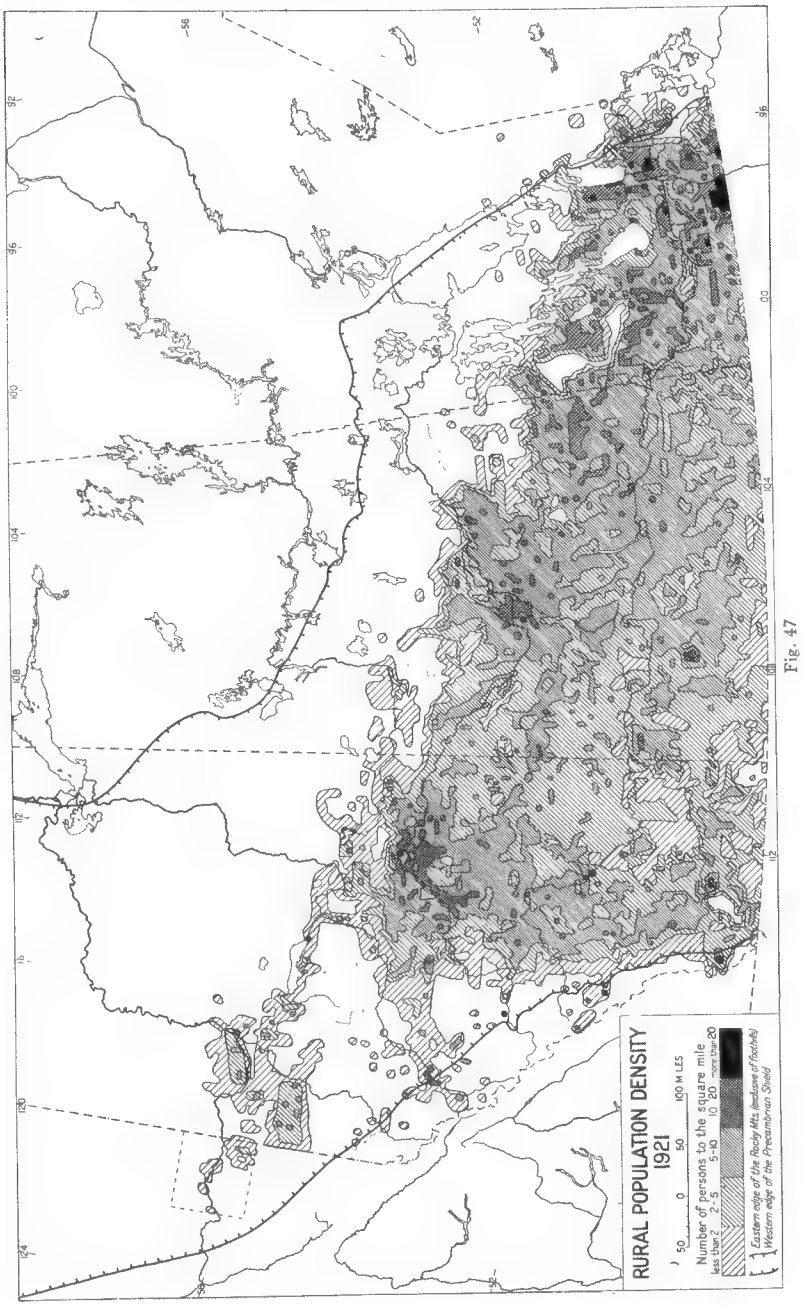

RURAL POPULATION DENSITY
1921
50 0 50 100 MILES
Number of persons to the square mile
less than 2 2-5 5-10 10-20 more than 20
Eastern edge of the Rocky Mts (exclusive of foothills)
Western edge of the Precambrian Shield

Fig. 47

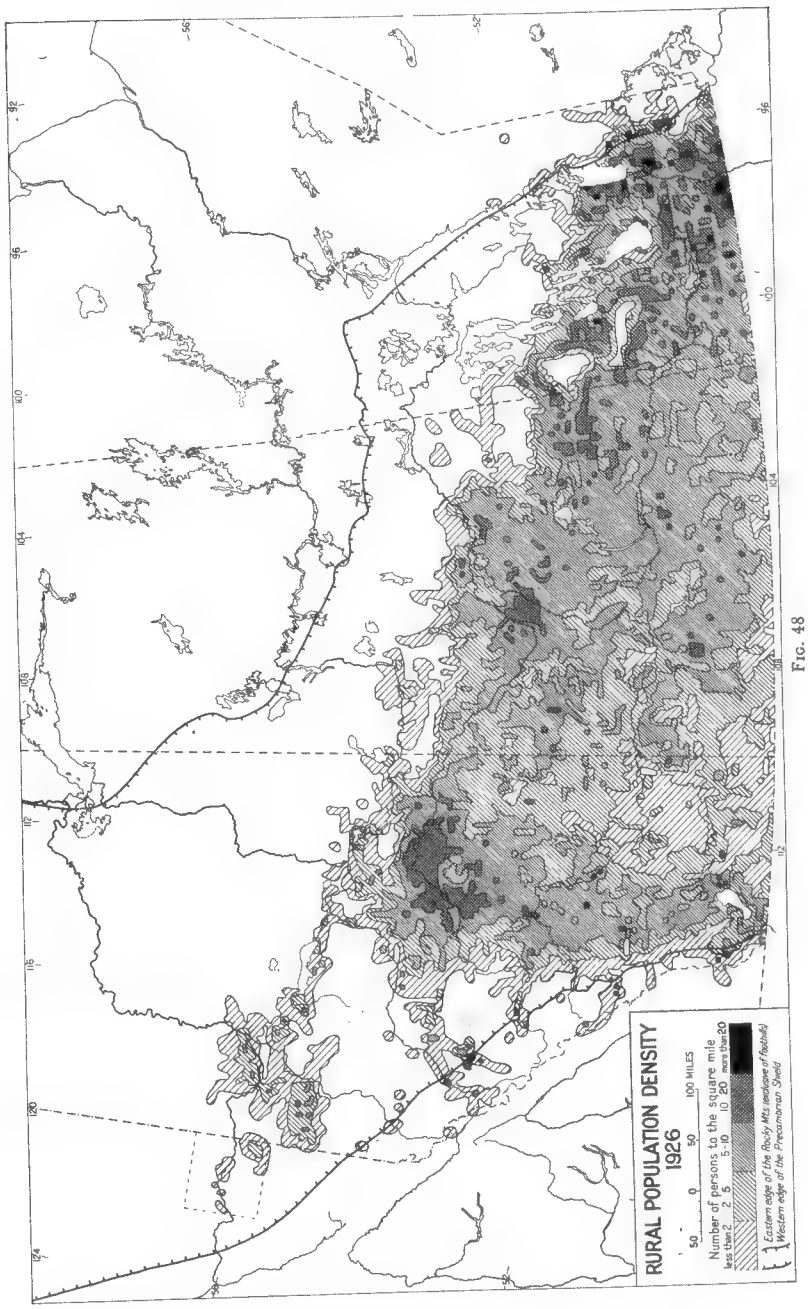

RURAL POPULATION DENSITY
1926
50 0 50 100 MILES
Number of persons to the square mile
less than 2
2-5
5-10
10-20
more than 20
Eastern edge of the Rocky Mts. (exclusive of foothills)
Western edge of the Precambrian Shield

FIG. 48

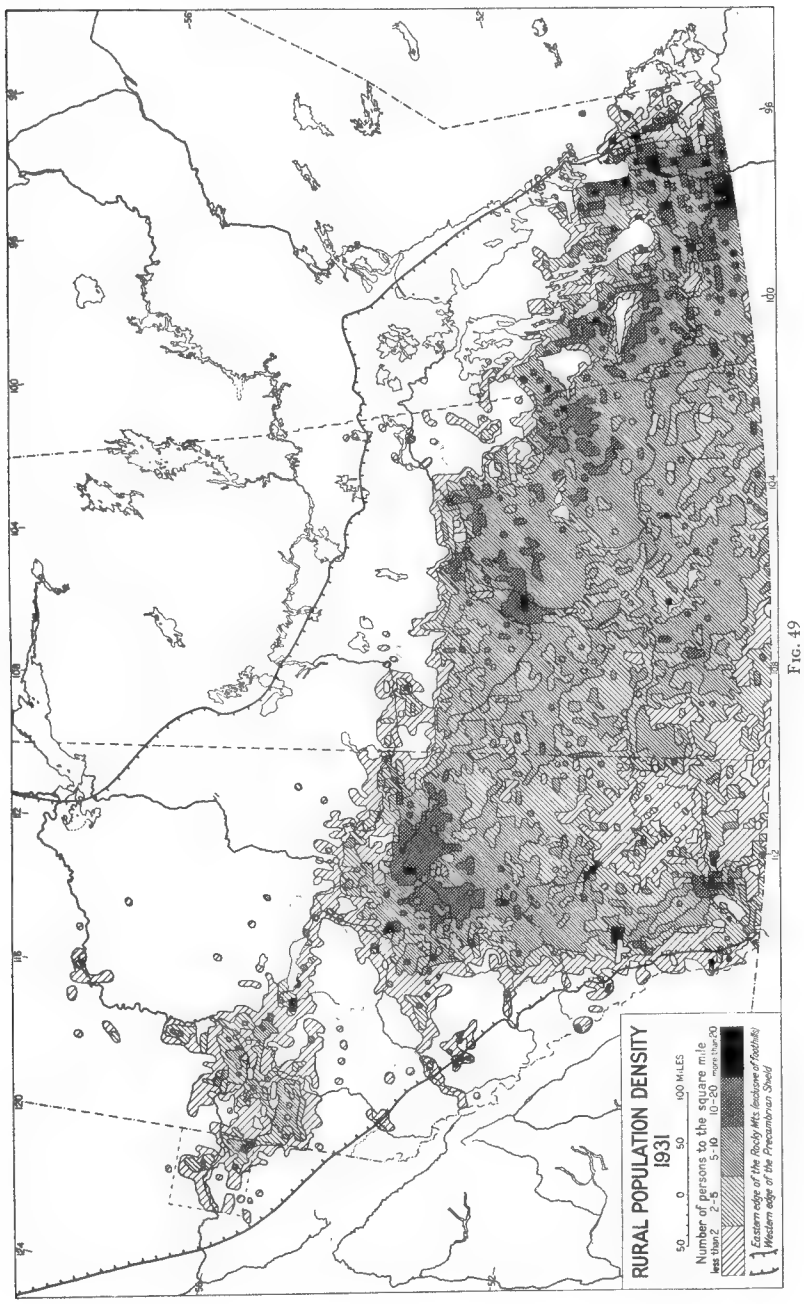

RURAL POPULATION DENSITY
1931
50 0 50 100 MILES
Number of persons to the square mile
less than 2
2-5
5-10
10-20
more than 20
Eastern edge of the Rocky Mts. (exclusive of foothills)
Western edge of the Precambrian Shield

FIG. 49

Settlement, mainly Icelandic, had pushed into the "interlake" country in Manitoba, but had avoided the sandy soils bordering Lake Manitoba on the west. A thin line of settlement marked the route of the Canadian Pacific Railway, and a substantial belt, made up mainly of ranching population in the south, extended from the international boundary to the Edmonton district. In spite of the southern location of the Canadian Pacific Railway, there is observable a definite bias in favour of the "fertile belt". Except in the valley of the Souris, there was no serious invasion of "Palliser's Triangle".

By 1906 (Fig. 44) settlement had swept rapidly across the Park Belt and across the dark brown prairie soils with their tall grass. The settler still avoided "Palliser's Triangle", the "dry belt", though its boundaries as Palliser had defined them had been encroached upon. The wooded country was preferred to the "dry belt"; population pushed further north between the Manitoba lakes, and encroached on the Forest Belt right across the north. The triangle of population in Alberta's Park Belt begins to become conspicuous in this map.

The map for 1911 (Fig. 45) records the progress of settlement at its most rapid rate. In the five years since 1906, the whole of "Palliser's Triangle" had been covered by a thin settlement, made up, in the main, not of ranchers but of farmers. The first settlers had entered the Peace River Valley, whose agricultural possibilities had been talked of years before. In the older settlements there was a marked increase in density. The northern limit of settlement had moved further into the timber soils, but its progress was slow. This map shows a "pioneer fringe" larger in extent than that on any other map. The broad fringe is the adjunct of rapid settlement. It had taken the thirty years since the Hudson's Bay purchase, or the ninety years since the founding of the Selkirk Settlement, to build up the meagre map of 1901. In a single decade the whole of the remaining prairie was covered, although scantily, with agricultural settlers.

A less rapid continuation of the same movements is shown in the map for 1916 (Fig. 46). The density of population increased throughout almost the whole area. The slow progress into the Manitoba and Saskatchewan forests continued. The area west of the Manitoba lakes is covered. The construction of the Edmonton, Dunvegan, and British Columbia Railway (now the Northern Alberta Railway) stimulated settlement in the Peace River Country.

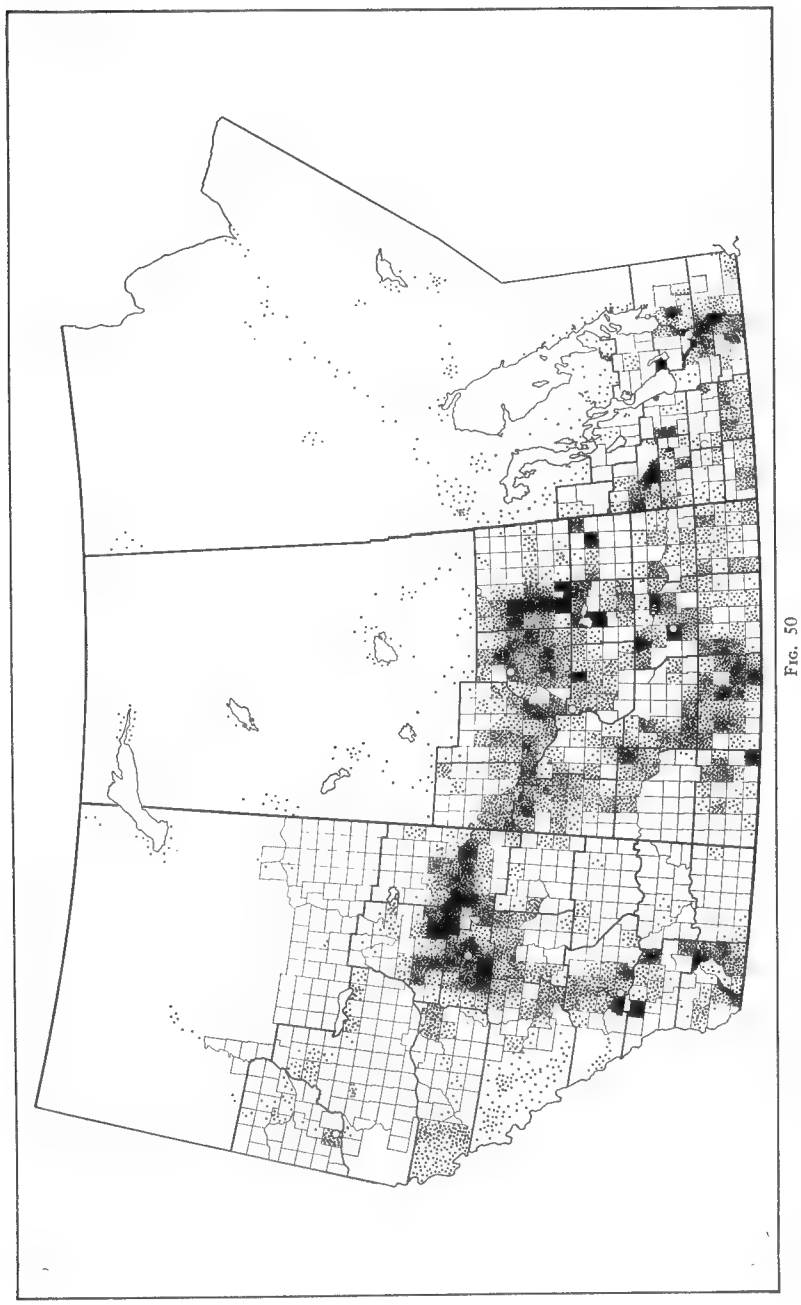


FIG. 50

FIGS. 50 and 51—Increase and decrease of rural population, 1921-26 (*Statistical Atlas*). Each dot represents 10 persons. The territorial unit is the municipality. The dots in unorganized territory have been distributed according to the best information available.

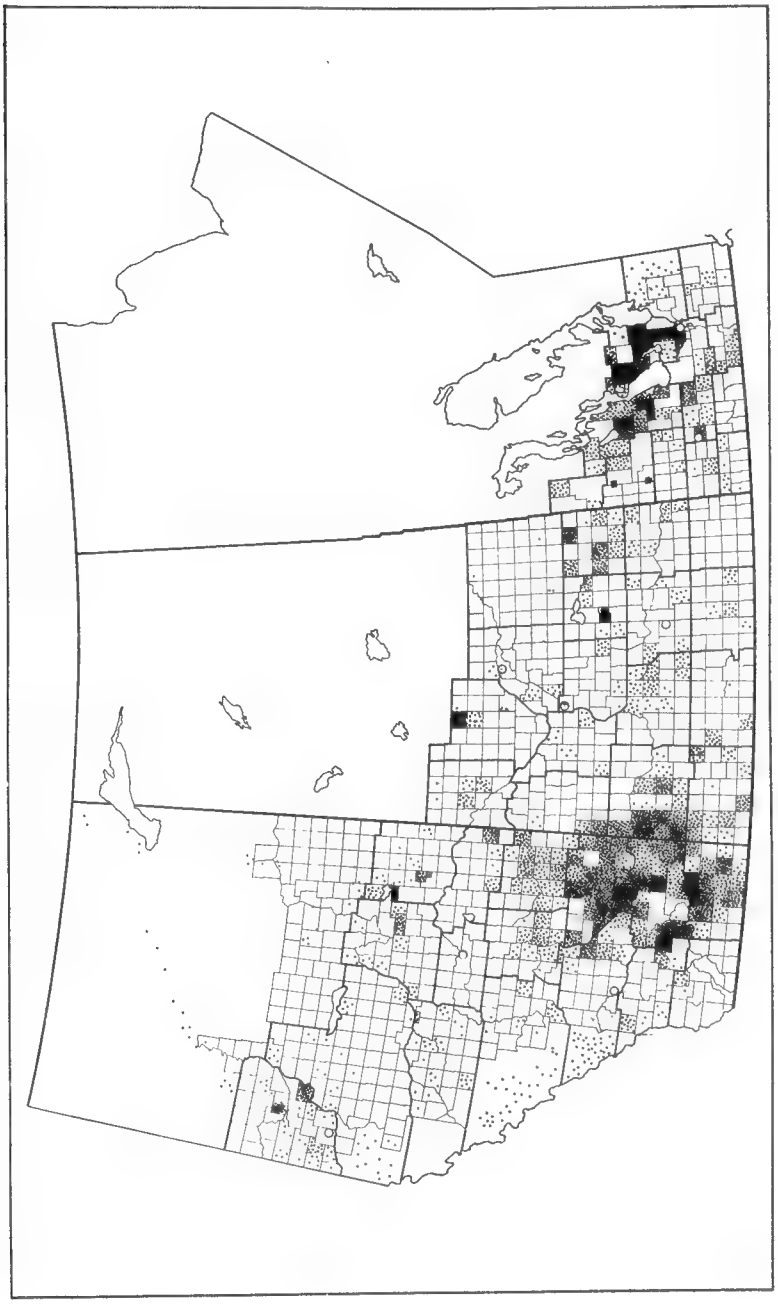


FIG. 51

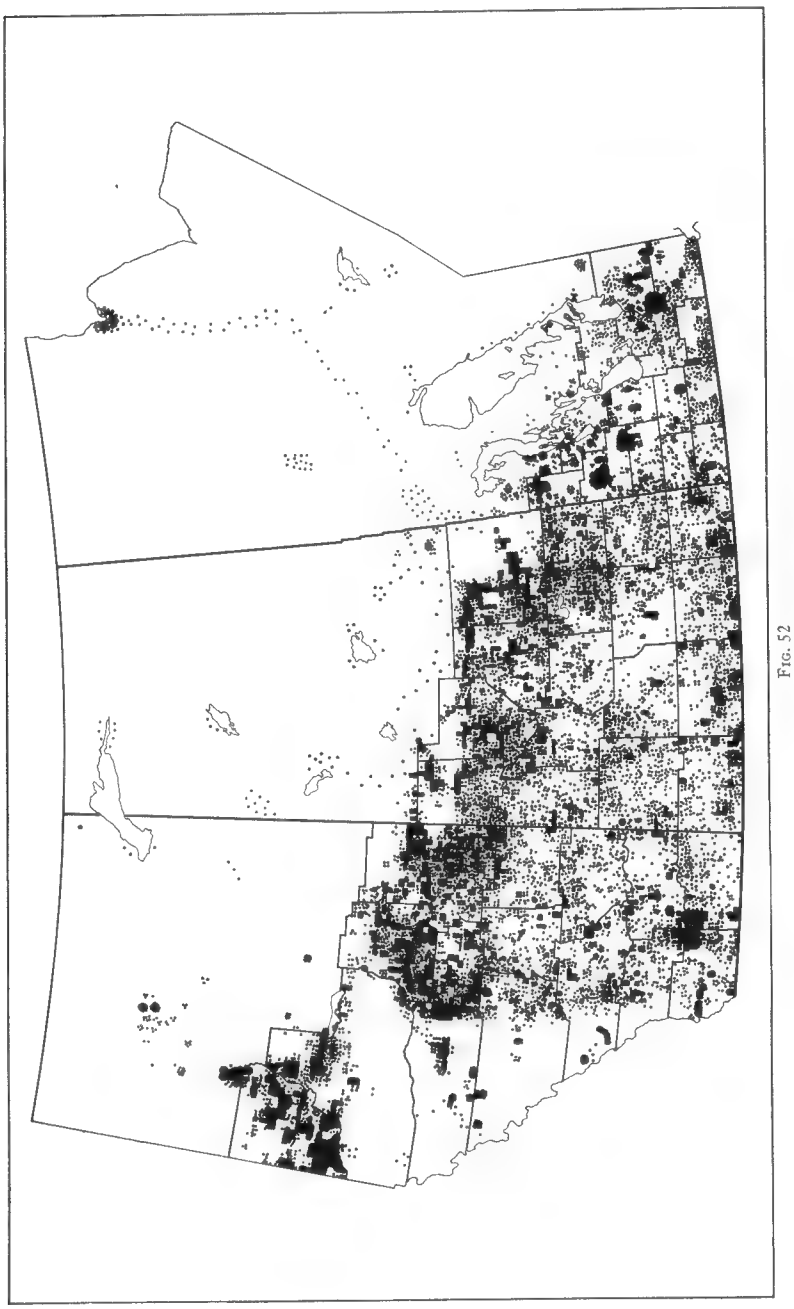


FIG. 52

FIGS. 52 and 53—Increase and decrease of rural population, 1926-32 (compiled from the censuses of 1926 and 1931). Each dot represents 10 persons. The territorial unit is the township. The dots in unorganized territory have been distributed according to the best information available.

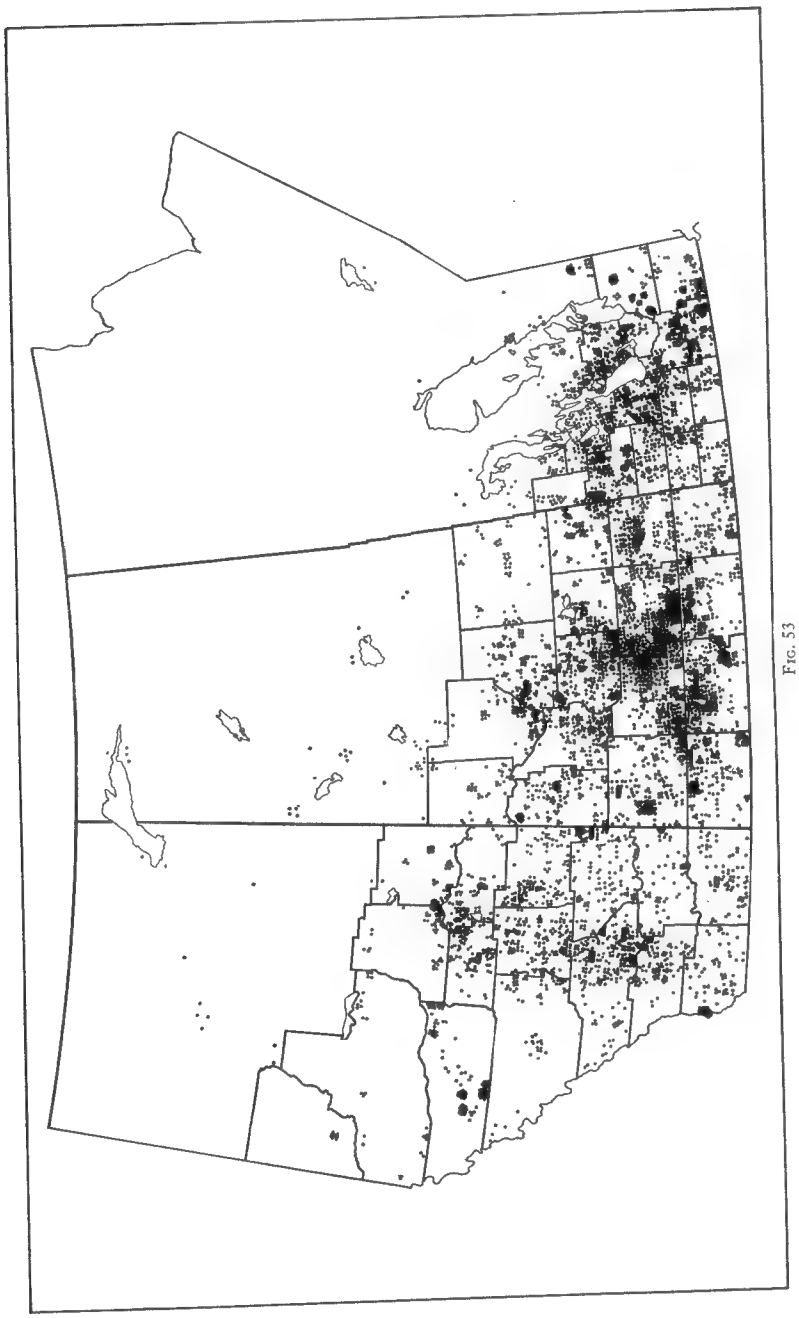


FIG. 53

On the map for 1916 fringe densities occur chiefly in areas where they are likely to continue for some time.

By 1921 (Fig. 47) war-time prices for wheat and other factors had substantially extended the limits of population in northwestern Saskatchewan, had greatly enlarged the area of the Peace River settlements, and had reduced markedly the fringe area in the semi-arid belt. A great part of the whole region of the West had reached a density of five to ten persons per square mile.

The map for 1926 (Fig. 48) records both advance and recession. The area having a population density of five to ten persons per square mile had increased. In the northern forest progress had been slow. In the valley of the Peace there had been extension but not much increase in density. The years of falling wheat prices and scanty crops (1920-23) had brought marked recessions. On both sides of Lake Manitoba population had declined. The advance into the centre of the "dry belt" had been turned into a retreat. The fringe area in southeastern Alberta was greatly extended by abandonment of farms. The Census of 1926 recorded 55 per cent. of the farms abandoned in Census District Number 3 in Alberta, the census district covering the major part of this fringe area (Fig. 70). As the accompanying maps (Figs. 52 and 53) showing increases and decreases in population between 1926 and 1931 record, increases in population took place mainly in the Park Belt, in the Forest Belt, and in the less arid parts of the prairie; decreases occurred in scattered areas, but most strikingly in the country between and west of the Manitoba lakes and in the area around Regina, which suffered badly from drought in 1929 and 1930. Between 1921 and 1926 decreases were most marked (Fig. 51) between the Manitoba lakes and in the heart of the semi-arid country.[3]

The most marked extension of settlement between 1926 and 1931 occurred in the Peace River Valley (Figs. 49 and 52). Settlement spread out from the small "prairies" north and south of the Peace into lightly wooded areas. In the Peace River Block of British Columbia north of 56°N. latitude, at Notikewin on the 57th parallel, on the Keg River near 58°N., at Fort Vermilion north of 58°, outposts of settlement have gone far beyond the railways. Progress in the forest country has been slow, but substantial

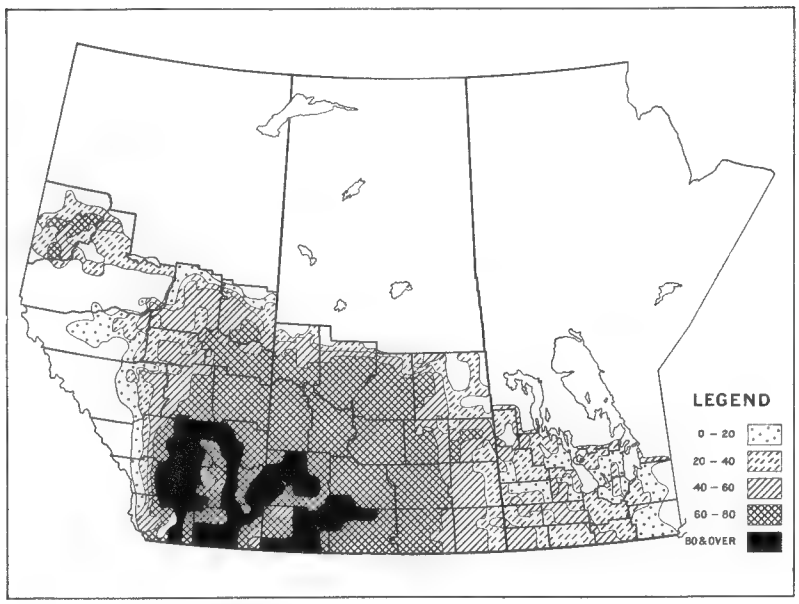
[3] *Agriculture, Climate, and Population of the Prairie Provinces of Canada, A Statistical Atlas Showing Past Development and Present Conditions*, Prepared under the direction of W Burton Hurd and T. W. Grindley (Ottawa. Dominion Bureau of Statistics, 1931), pp. 83, 84.

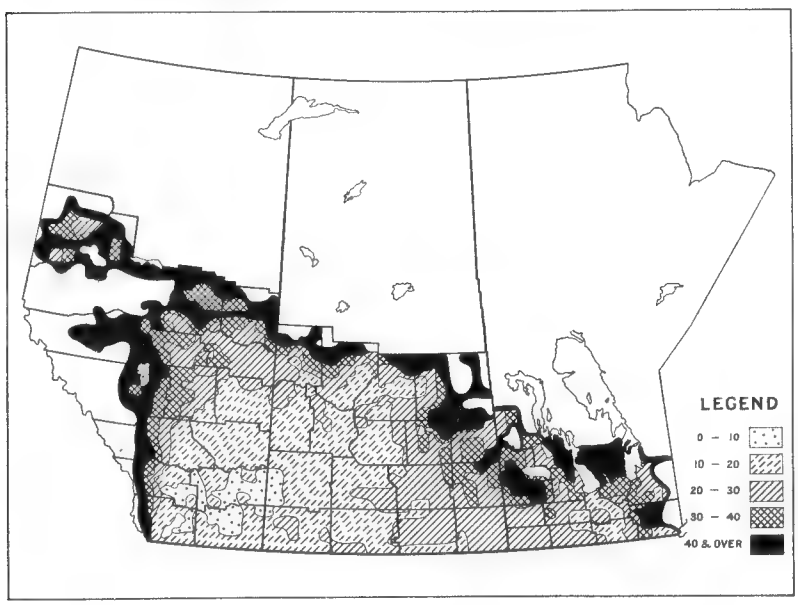
extensions have taken place in northwestern Saskatchewan along the Beaver River, and in northeastern Saskatchewan across the Saskatchewan River, in the valley of the Torch, and down the Carrot River valley.

Comparison of the density of population map for 1931 with the maps in Chapter I will indicate the obvious influence of certain physical controls. It is not to be expected that a single physical factor will determine the density of population in a particular area. Heavy drought-resisting soils may permit farming in areas where the rainfall is inadequate for light sandy soils. Injury to one crop in five may discourage settlement in one district where soil is poor and clearing expensive, and not in another in which other factors are favourable. Only by taking all factors into consideration can one discern coincidences of favourable or unfavourable circumstances which strikingly affect the density of agricultural settlement.

One expects to find, in an agricultural area in a region in which rainfall is normally deficient, a correlation between rainfall and rural population density. In semi-arid districts the poorer soils and the lands of broken topography are frequently unoccupied or, having been occupied, are abandoned. Better soils may be devoted to grazing—a use supporting a smaller population per square mile than agriculture. Where land in semi-arid districts is devoted to agriculture, the normal size of farm is larger and the yield per acre smaller than in districts where rainfall, though deficient, is less inadequate. Scanty rainfall supports a scanty population because some land is not used at all, and because the remainder is used extensively rather than intensively.

Comparison of rural population densities with the map showing average annual precipitation (Fig. 16) reveals that, while areas of low precipitation have, generally speaking, a low density of population, there is no accurate correspondence of boundaries. While some of the area having an annual rainfall of less than 13 to 15 inches has a population density of 5 to the square mile or less (Fig. 49), other parts in southwestern Saskatchewan have populations well up to the common density of 5 to 10 persons per square mile. Greater correspondence is apparent between rainfall in the growing season (Fig. 17) and rural population density. The boundary of the belt normally having 9 inches or more of rainfall during the growing season corresponds fairly accurately in the southwest





FIGS. 54 and 55—Percentage of field crop acreage in wheat and oats, respectively, 1926 (compiled from the Census of Manitoba, Saskatchewan, and Alberta, 1926). The territorial unit is the municipality.

with the boundary of the belt having a population density of 5 to 10 persons per square mile. Intrusions of denser population into this area, as in the spur shown northwest of Swift Current, are to be explained in part by the presence of heavier soils capable of resisting drought.[4]

In the north rainfall is a less decisive factor. Evaporation is presumably less; the poorer timber soils and the cost of clearing

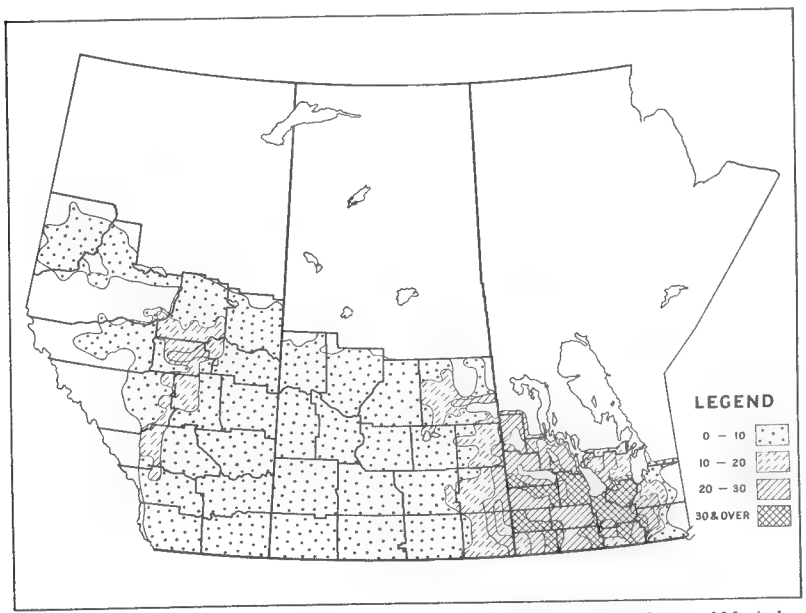


Fig. 56—Percentage of field crop acreage in barley, 1926 (compiled from the Census of Manitoba, Saskatchewan and Alberta, 1926). The territorial unit is the municipality.

land limit settlement. What scarcity of moisture is in the south, frost is in the north. Where not limited by other factors, northward advance is held in check by the shortness of the growing season for cereals. The map showing the length of the growing season from the average date of seeding to the average date of the first killing frost in the late summer or autumn (Fig. 22) depicts, with fair adequacy, the climatic limitations to agriculture and particularly to wheat growing in the north. It will be seen from Figure 54 that comparatively little wheat is grown north of the line marking a

[4]*Soil Survey of the Leader-Maple Creek Area* (Saskatoon: University of Saskatchewan, College of Agriculture, Soil Survey Report, No. 8, 1929), pp. 9-11.

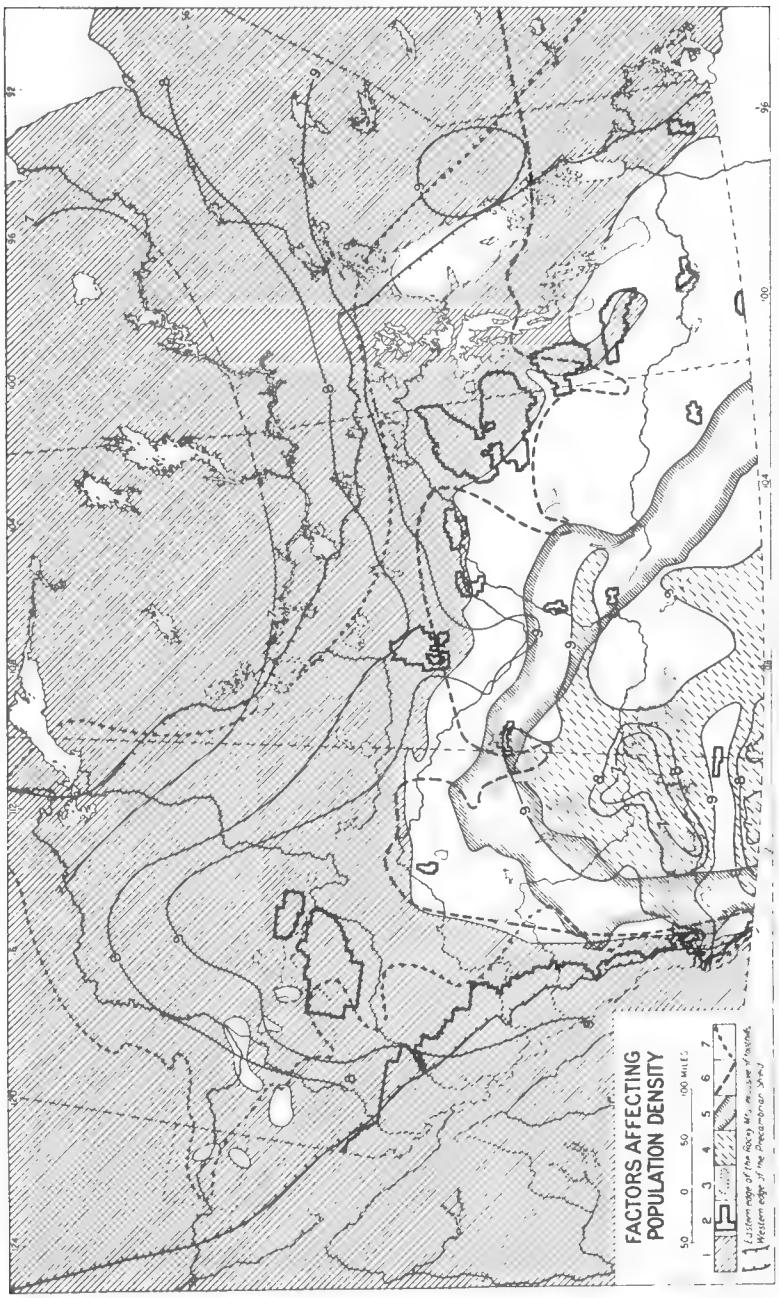


FIG. 57—Factors affecting population density. Key to numerals: 1, forest (see Fig. 23); 2, forest and other reserves; 3, sand dunes (see Fig. 24); 4, southern area of less than 9-inch summer rainfall (see Fig. 17); 5, boundaries of dark brown soil belt (see Fig. 24); 6, line north and west of which the growing season is less than 130 days (see Fig. 22); 7, northern limit of wheat growing, after Unstead. (Compare with Figs. 43-49).

"growing season" of 130 days. This does not mean, of course, that expansion of agriculture and of population is controlled by the shortened growing season alone. Other factors are operative both in Manitoba and Saskatchewan, while in Alberta there is still a good deal of land of fair quality available within the area with a growing season of more than 130 days. More will be found on this topic in the chapter on the Probable Limits of Settlement.

TABLE III—DAYS REQUIRED TO MATURE VARIETIES OF SPRING WHEAT ON DOMINION EXPERIMENTAL FARMS, 1926-30*.

VARIETY	FORT VERMILION ALBERTA†	BEAVERLODGE ALBERTA	LACOMBE ALBERTA	LETHBRIDGE ALBERTA	SWIFT CURRENT SASK.	SCOTT SASK
Marquis	108 5	127 4	122 6	115 0	103 6	111 2
Garnet. .	102 3	121 0	114 0	107 0	99 0	102 3
Reward ..	101 5	121 1	115 0	110 0	101 0	104 1

VARIETY	ROSTHERN SASK	INDIAN HEAD SASK	BRANDON MANITOBA	MORDEN MANITOBA
Marquis. ..	116 6	112 8	105 3	110 6
Garnet.. .. .	108 2	102 0	99 6	103.4
Reward..	109 4	104 2	100 8	105 4

* *Report of Dominion Cerealist, 1930* (Ottawa. Department of Agriculture, 1931), p. 26.

† Includes years 1925, 1926, 1927, 1929, *Reports of Experimental Sub-Stations*, 1925-29 (Ottawa· Department of Agriculture)

As the settler fought drought with the moisture-conserving practices of dry farming, so he has met the short growing season with quickly-maturing varieties of grain. The general introduction of Red Fife wheat by 1900, of Marquis by 1912, and of Garnet and Reward wheats by 1929 mark definite stages in the northward progress of wheat growing.

The limitations which the short growing season places on agriculture can be more accurately pictured through examination of maps showing the proportions of field crop acreage devoted to individual crops (Figs. 54-56). As the growing season shortens from 140 days, the proportion of acreage devoted to wheat declines, and the proportion sown to oats rises from 30 to more than 90 per cent.

/As already indicated, the topography of the Prairie Provinces is, in general, favourable to settlement. There are few areas in which rough topography alone would be a serious barrier.) Physical and economic facts, however, have prescribed for the region an agricultural economy to which broken and rough topography is a handicap. Cheap land, a short growing season, scanty rainfall, expensive labour, and a predominance of spring wheat—these concentrate agricultural effort on short intensive work, during seeding and harvest. Even though rough land would produce as good crops as the more level country, *there is not time enough to cultivate it.* The machinery with which the grain farmer economizes his expensive factor, labour, and makes the most of the cheap factor at his disposal, land, cannot accomplish these things on rough broken land. Only such land can be cultivated as can be *quickly* cultivated.

Topography is a more important factor affecting the density of population on the third prairie level, and particularly in the semi-arid section, than elsewhere. "There is a notable difference, therefore, in the topography of the sub-humid and semi-arid sections. Probably no other agricultural region of North America, except possibly the Corn Belt, and the Winter Wheat Region to the south, possesses so large a proportion of topographically arable land as the sub-humid section; and by contrast few non-mountainous areas possess so much rough land as the semi-arid section in the United States and southwestern Saskatchewan".[5] There is, however, a much greater proportion of rough land in the United States section than in the Canadian section. It is estimated that nearly half the land in the United States section is too rough for tillage, while in Canada nearly seventy per cent. of this section is potentially arable.[6]

The accompanying map (Fig. 57) indicates the areas in which scanty precipitation, forest growth, poorer soils, and a short growing season are factors limiting the density of population. It cannot show, of course, the degree of the importance of each. It will be seen that these physical factors account for the population deficiencies by which some areas fall short of the common population density of five to ten persons per square mile. An exception, of course, will be found in the pioneer fringe, where active settlement is in

[5] O. E. Baker, "Agricultural Regions of North America, Part VI. The Spring Wheat Region", *Economic Geography*, Vol. 4 (1928), p. 410.

[6] *Op. cit.*, pp. 416-7.

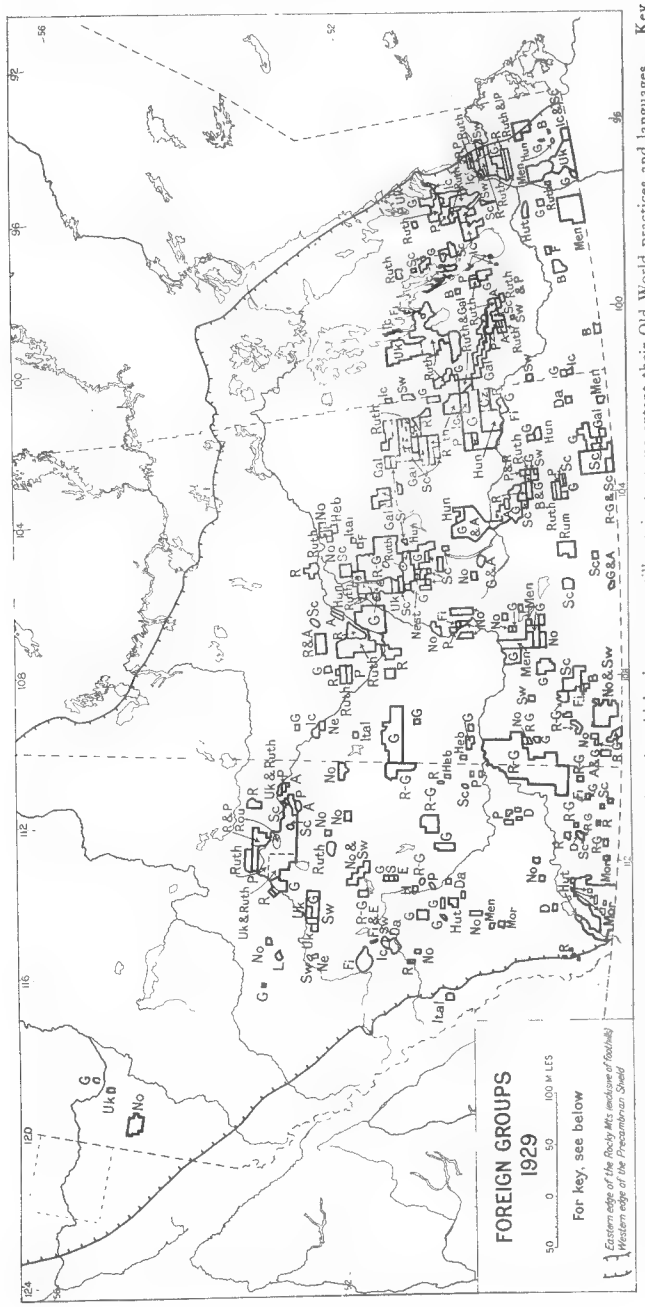
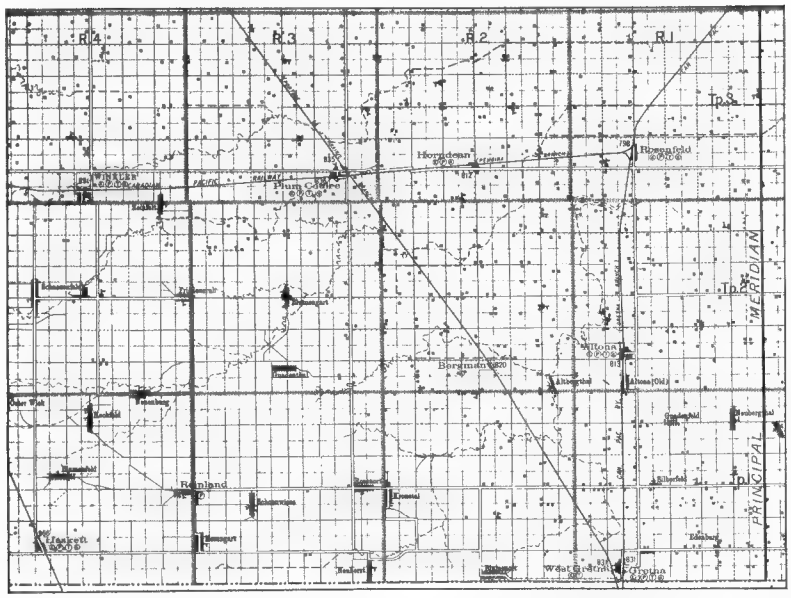


FIG. 58.—Foreign groups, 1929. The areas outlined are those in which the groups still retain to some extent their Old World practices and languages. Key to symbols: A, Austrians; B, Belgians; Cz, Czecho-Slovaks; D, Dutch; Da, Danes; E, Estonians; F, French; Fi, Finns; G, Germans; Gal, Galicians; Heb, Hebrews; Hun, Hungarians; Hut, Hutterites; Ic, Icelanders; Ital, Italians; L, Letts; Men, Mennonites; Mor, Mormons; Ne, Negroes; Nest, Nestorians ("Assyrians"); No, Norwegians; P, Poles; R, Russians; Rum, Rumanians; Ruth, Ruthenians; S, Swiss; Sw, Swedes; Sc, Scandinavians (undifferentiated); Uk, Ukrainians.



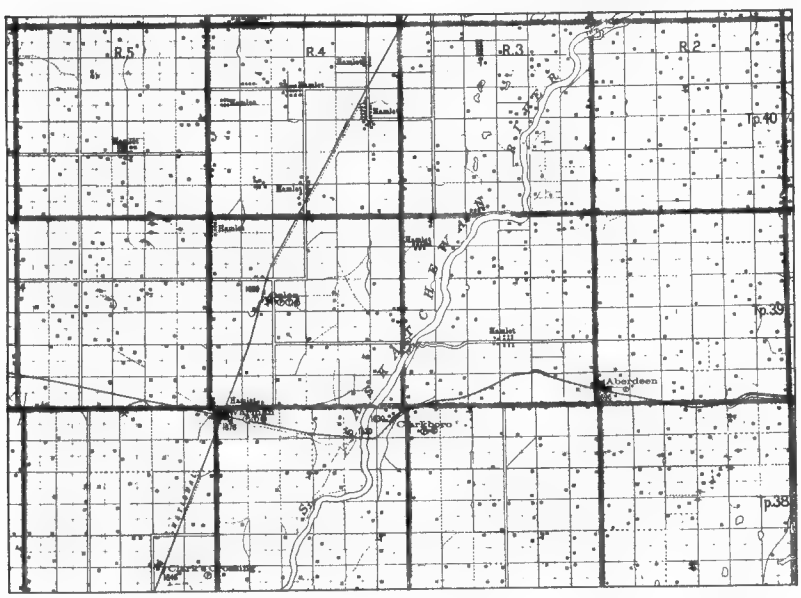


Fig. 59—Topographic factors and distribution of buildings in area having a rural population density of 5-25 persons per square mile, upper Red River Valley (based on the "Sectional Maps" of the Topographical Survey of Canada). Note the agricultural villages of the European type.

Fig. 60—Topographic factors and distribution of buildings in an area having a population density of 5-15 persons per square mile, northeast of Saskatoon (source as in Fig. 59).

progress and where higher densities of population will be achieved, and in remote areas where railway transport is lacking.

It is difficult, however, to account, by reference to physical controls, for population densities of more than ten to the square mile. It is true these densities occur most frequently in areas where the physical environment is favourable, particularly in the Park Belt, but they also occur where the physical influences are

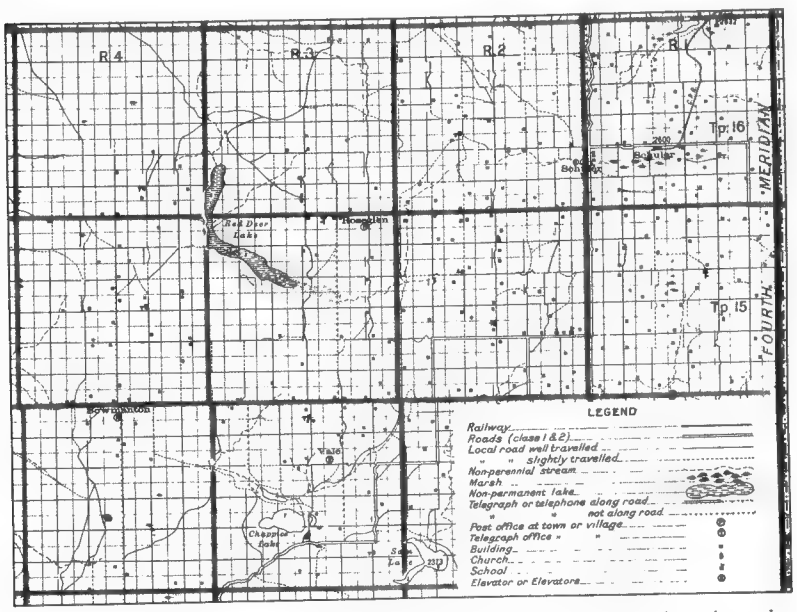


FIG. 61—Topographic factors and distribution of buildings in area having a rural population density of less than five persons per square mile, north of Medicine Hat (source as in Figs. 59 and 60). Note the scattered and uneven distribution of buildings. The extent to which local roads "angle" across quarter sections is evidence of the degree to which land is unoccupied or used only for grazing.

not particularly favourable, as along the western shore of Lake Winnipeg. Even a hasty glance at Figure 58 in conjunction with Figure 49 will show that higher densities of rural population are in the main associated with the non-Anglo-Saxon groups in Western Canada. Rural population densities of more than ten persons per square mile, if continuous for several townships, are almost invariably associated with foreign language groups, particularly those of Central European origin. The more densely populated sections east and west of the Red River, on the west shore of Lake

Winnipeg, east and south of the Duck and Riding Mountains, in east-central Saskatchewan, north of Saskatoon, and in the Edmonton district, all possess large distinctive foreign language-groups.

In some measure, the smaller farms and the more intensive farming favoured by the settlers from Central Europe explain the greater density of population. This is strikingly true where the

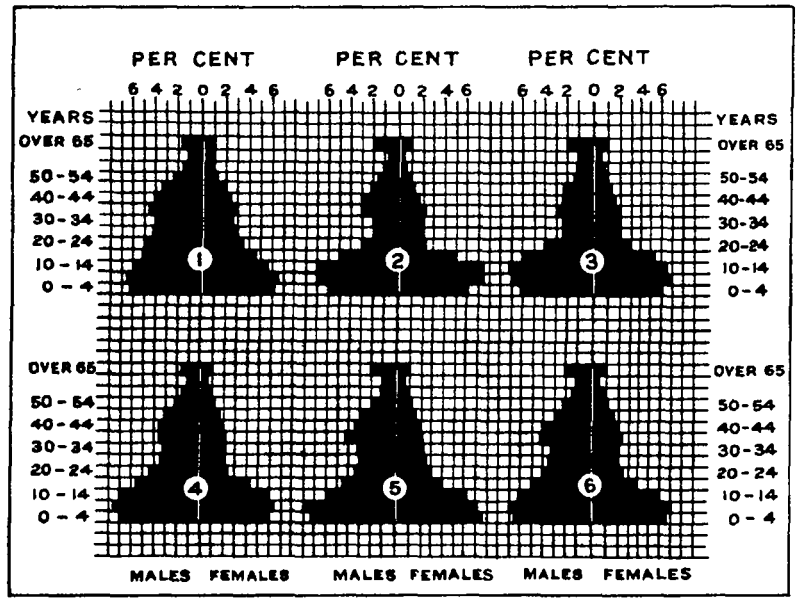


FIG. 62—Age and sex distribution of rural population, Prairie Provinces, 1926 (data provided by the Dominion Bureau of Statistics) Key to numerals: 1, the Provinces of Manitoba, Saskatchewan, and Alberta; 2, Census Division 12 in Manitoba, 3 and 4, Census Divisions 9 and 10 in Saskatchewan, 5 and 6, Census Divisions 13 and 14 in Alberta.

agricultural village of the European type has been transplanted to the Canadian plains, as in the Mennonite communities along the international boundary west of the Red River, north of Saskatoon, and south of Swift Current. The accompanying sections from sheets of the topographical map (Figs. 59, 60, 61) shows the distribution of dwellings in this type of settlement. For the most part, however, the greater population density of these areas reflects the larger families which distinguish the Central European communities. On Figure 62 is shown the age and sex distribution of

the rural population in 1926 in certain census districts. The high proportions of children in Census Divisions 12 in Manitoba, 9 and 10 in Saskatchewan, and 13 and 14 in Alberta, are associated with communities of Central European origin and with relatively dense population.

CHAPTER V

THE RED RIVER VALLEY AND THE PARK BELT

PHYSIOGRAPHICALLY the interior plain of North America forms one region. That region, however, is subdivided into a number of sub-regions differing from one another in topography, climate, vegetation, and soil. The Canadian section of the interior plain can be usefully divided into five sub-regions: (1) the Red River Valley, (2) the Park Belt, (3) the Prairie Plains, or semi-arid belt, (4) the Forest Belt, and (5) the Peace River Valley. This classification is not drawn on strictly logical lines. The distinctions between the Park Belt, the Prairie Plains, and the Forest Belt are primarily based on differences in rainfall and secondarily on differences in vegetation and soil. The Red River Valley is really the most humid part of the Park Belt, but its early settlement and distinctive topography and soil make it desirable to separate it from the Park Belt. The Peace River Valley includes some "islands" of park country surrounded by the northern forest. By reason of its northern latitude and the recent period of its settlement, it too can best be treated as a separate sub-region.

Red River Valley

The Red River Valley, stretching from Lake Traverse in Minnesota to Lake Winnipeg, bounded on the east by the Precambrian Shield and on the west by the Manitoba Escarpment, is geographically a unit, not so much because it is a single drainage basin as because its plain was built by the deposits of the glacial Lake Agassiz. As the ice-sheet retreated, water was ponded in a vast shallow lake whose ancient beaches form the present boundaries of the Red River Valley. The waters of this lake retreated, leaving the Red River meandering northward through a level grassland plain, and leaving remnants of itself in Lakes Winnipeg, Manitoba, and Winnipegosis.

The whole of the Red River Valley has an annual rainfall of 18 to 21 inches, of which 11 to 12 inches normally falls between

April 1 and September 1 (Figs. 16, 17). The mean summer temperature (62°-64°; Fig. 14) is higher than that in any other part of the Canadian West, except that in the centre of the semi-arid belt. The growing season ranges from 160 to 170 days (Fig. 22), a period exceeded only by that of southern Alberta. "The climate favours the growth of all classes of farm crops, both cereals and grasses. It is possible to mature early varieties of corn in most seasons".[1] This relatively warmer, more humid climate, promoting abundant growth of grasses, has converted the clay deposits of Lake Agassiz into a rich black clay loam. The tenacious black surface soil ranges from 4 to 12 inches in depth. It contains greater quantities of nitrogen and phosphorus than any of the western soils except the best of the Park Belt soils.[2]

The surface is characteristically flat, broken only by the shallow channels of the rivers. In contrast with the Park Belt, trees grow only along the rivers. The level topography has made it necessary to supplement natural drainage by extensive systems of open drains. In the heavy clay districts good wells are uncommon, and the chief source of water for farm use is the surface water stored in "dug-outs", or reservoirs dug in the clay (Fig. 82).

Though drainage is still a problem, the Red River Valley contains a larger proportion of arable land than any other division of the Canadian West. It is estimated that out of a total of more than 2,000,000 acres of land, 70 per cent. is suitable for cultivation, 15 per cent. is marginal, and 15 per cent. is not suitable for cultivation.[3]

Eighty-five per cent. of the total land area in the municipalities of the Red River Valley is in occupied farms, and 79 per cent. of the occupied land is improved; of the land occupied 7 per cent. in 1926 was in woodland and 13 per cent. in natural pasture. Murchie reported in 1926 that, of 2,800,000 acres, only 168,000 acres were "unused". Most of this unused land was located in the municipalities east of the Red River, where lack of drainage and, in the lower valley along the old beaches, stony land are limiting factors, and in a small area south of Portage la Prairie, where sand dunes are an obstacle to settlement.

"The Red River Valley was at one time the great wheat-producing

[1] R. W. Murchie and H C Grant, *Unused Lands of Manitoba* (Winnipeg. Department of Agriculture and Immigration, 1926), p. 24.

[2] See Appendix, p. 225.

[3] See Appendix, pp. 228-229.

Fig. [illegible].—The Carrot River [illegible] near Melfort, [illegible] Park Belt area (Canadian National Railways)

area of Manitoba, but today, while it is still essentially a grain country, wheat is giving place to other cereals."[4] In 1921, in the municipalities included in the valley, the acreage sown to wheat ranged from 20 to 60 per cent. of the total field crop acreage, the average being approximately 48 per cent. Between 1921 and 1926 wheat growing had declined proportionately in every municipality except two (Fig. 104). Generally speaking, oats also declined in importance. On the other hand, barley became of first-rate importance (Fig. 56). Whereas in 1921 in only one municipality did barley account for more than 30 per cent. of the field crop acreage, in 1926 this percentage was exceeded in ten municipalities, in two of which from 40 to 50 per cent. of the total field crop acreage was sown to barley. Flax and rye also increased in importance. This striking change in land utilization is occasioned by the pressing problem of weeds, whose growth is stimulated in a sub-humid climate by continued wheat growing. Barley, being harvested earlier, permits late summer tillage for weed control.

Though the income derived from livestock is relatively higher than in most other parts of the Prairie Provinces, it is only a fraction of that derived from the sale of grain (Figs. 110, 111).

The Red River Valley has been settled longer than any other part of the Canadian plains. Its climate and soils are well known and understood. Its problems are not pioneer problems but those of maturity. Weeds and rust are more serious than drought and frost, and are forcing changes in land utilization. With changes in land utilization changes in rural population may occur. Increases are likely to come, however, only as the urban area of Winnipeg affords a larger market for meat, dairy products, and other produce of a more diversified agriculture.

The Park Belt

The Park Belt (Fig. 23) is distinctive in its climate, vegetation, and soil. In some measure it is also distinct in topography. Its level or gently rolling surface is broken only by the rivers and the "breaks" along their banks. Erosion has not dissected this sub-humid area as it has the semi-arid plains embraced by it. Glacial moraines in Moose Mountain, the Touchwood Hills, and elsewhere rise above the surrounding country and are capped with forest. Small patches of woodland "bluffs" (Fig. 66) dot the surface of this

[4] Murchie and Grant, *op. cit.*, pp. 80-90.

belt, being denser and more frequent along the outer margin where the forest has encroached on the grassland, and less frequent as the inner or prairie margin is approached. Though in detail there is a much greater variety of topography than these generalizations would suggest, and though erosion has dissected the plateau more on the third prairie level than on the second, the topography of

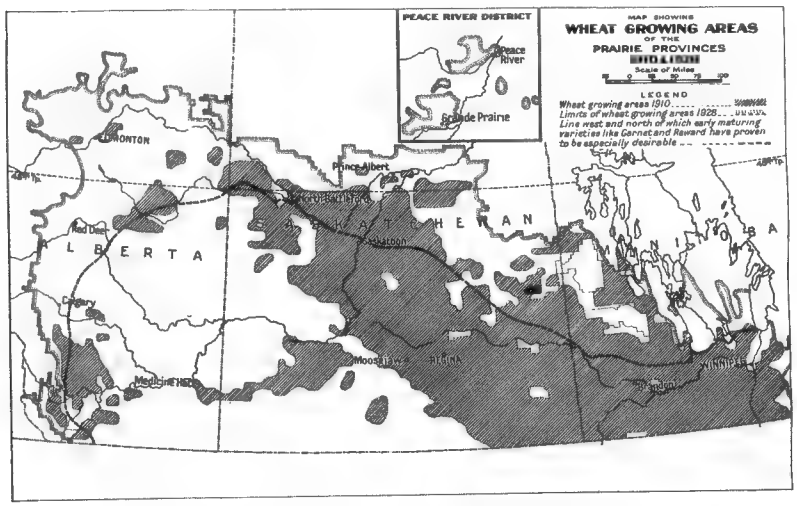


Fig. 64—Wheat growing areas of Western Canada, 1910 and 1928. Note the southern limit of the optimum area for the hardy Garnet and Reward wheats. (National Development Bureau, Ottawa.)

the Park Belt is peculiarly favourable to agriculture and to machine-agriculture on a relatively large scale.

The Melfort district in the Carrot River valley in northeastern Saskatchewan is a superior parkland area (Fig. 63).

The main central part of the Melfort Plain has a parkland vegetation. In this vegetation belt clumps of trees have established themselves on the prairie grassland, and there is evidence that at the time of settlement there was a tendency for these clumps of trees to become more and more numerous and that a gradual encroachment of the tree vegetation was overtaking the prairie. Such clumps of trees are commonly called "bluffs" in the West. The term "bluff", in this sense, is quite descriptive of these small hill-like clusters of trees rising above the general level of the prairie. The trees comprising these clumps are usually poplars, which grow to a height of from twenty to thirty feet. In low-lying damp places various species of willows are found. A single

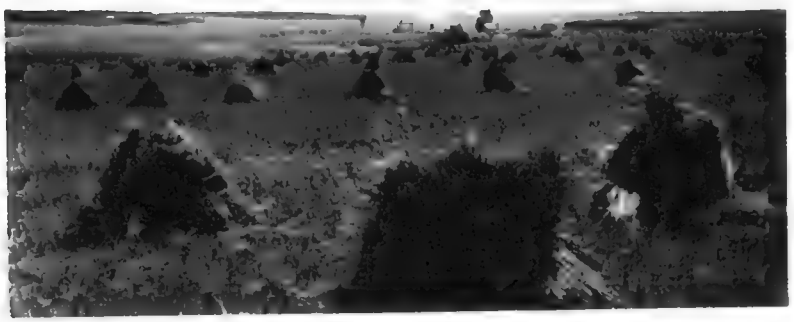


FIG. 65—The Carrot River valley (Canadian National Railways).

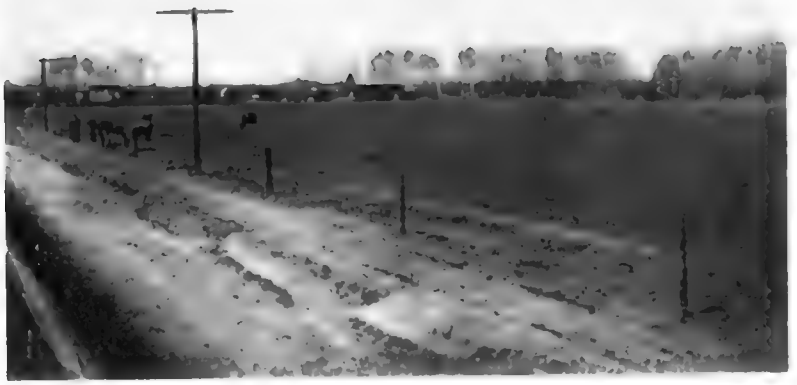
FIG. 66—Characteristic Park Belt country on the third prairie step. Note rolling topography and "bluffs". (Canadian National Railways.)

clump is rarely very extensive. In general they range in size from about nine square rods to two or three acres. The amount of clearing necessary varies considerably with the density and type of tree and brush vegetation, but the clearing problem is seldom as important as on lands located in the timber belts.[5]

FIG. 67—An Alberta black park soil profile. Note the black surface layer over a foot thick. (Alberta Soil Surveys.)

Climatically the Park Belt shares the characteristics of the whole plains or "steppe" region, yet it is distinctive in being subhumid, bounded on one side by the humid (forest) belt and on the other by the semi-arid (prairie) zone, and in being subject, along the forest margin, to early frosts. The Park Belt has an annual rainfall of 14 to 20 inches, the amount in the Alberta and Manitoba sections being greater on the whole than in the Saskatchewan section (Fig. 16). Rainfall in the humid forest country to the east in Manitoba and to the west in Alberta is greater, but in the humid area of northern Saskatchewan it is less than in the Park Belt. Presumably the forest of northern Saskatchewan is humid because evaporation is low rather than because rainfall is heavy. Normal rainfall during the five months of the growing season ranges from 9 to 14 inches (Fig. 17), being greater in the southern and less in the northern sections of the Park Belt.

[5] A. H. Joel, F. H. Edmunds, J. Mitchell, *Soil Survey of the Birch Hills-Melfort Area* (Saskatoon: University of Saskatchewan, College of Agriculture, 1928), p. 37.



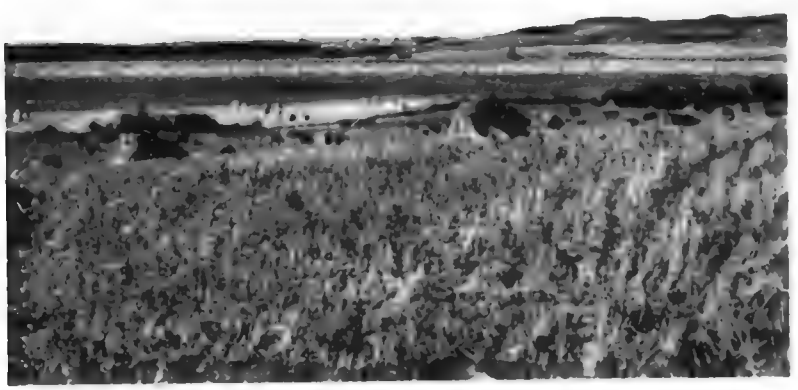


FIG. 68—The extreme north of the Park Belt in Manitoba: the Swan River Valley.
FIG. 69—The northern edge of the Park Belt in Alberta near St. Paul de Métis (Figs. 68 and 69 from Canadian National Railways).

Rainfall is sufficient not only for the small grains but also for timothy, brome grass, and some of the clovers.

Frost in the Park Belt is one of the risks of farming. It does not impose serious limitations on farming, but it is definitely a factor. The growing season (i.e., the number of days between the average date of seeding and the average date of the first killing frost) ranges from 130 to 160 days. In the southern part of

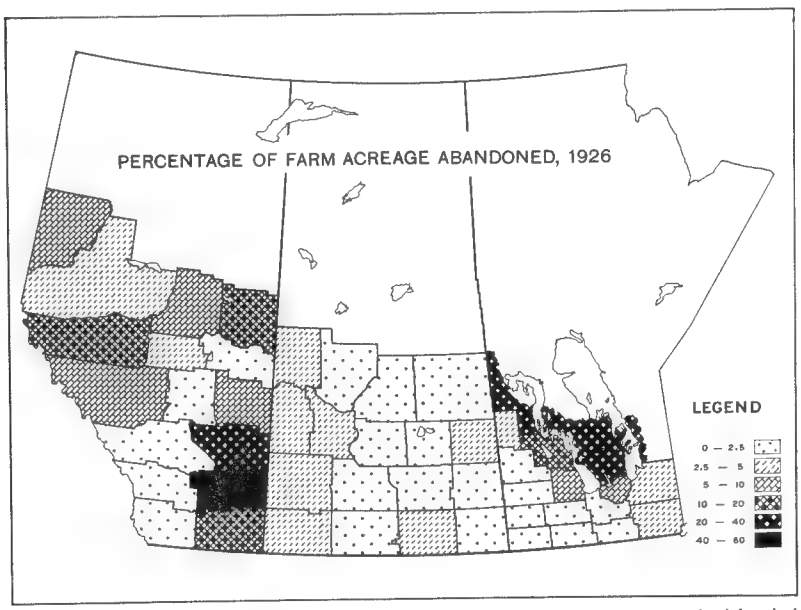
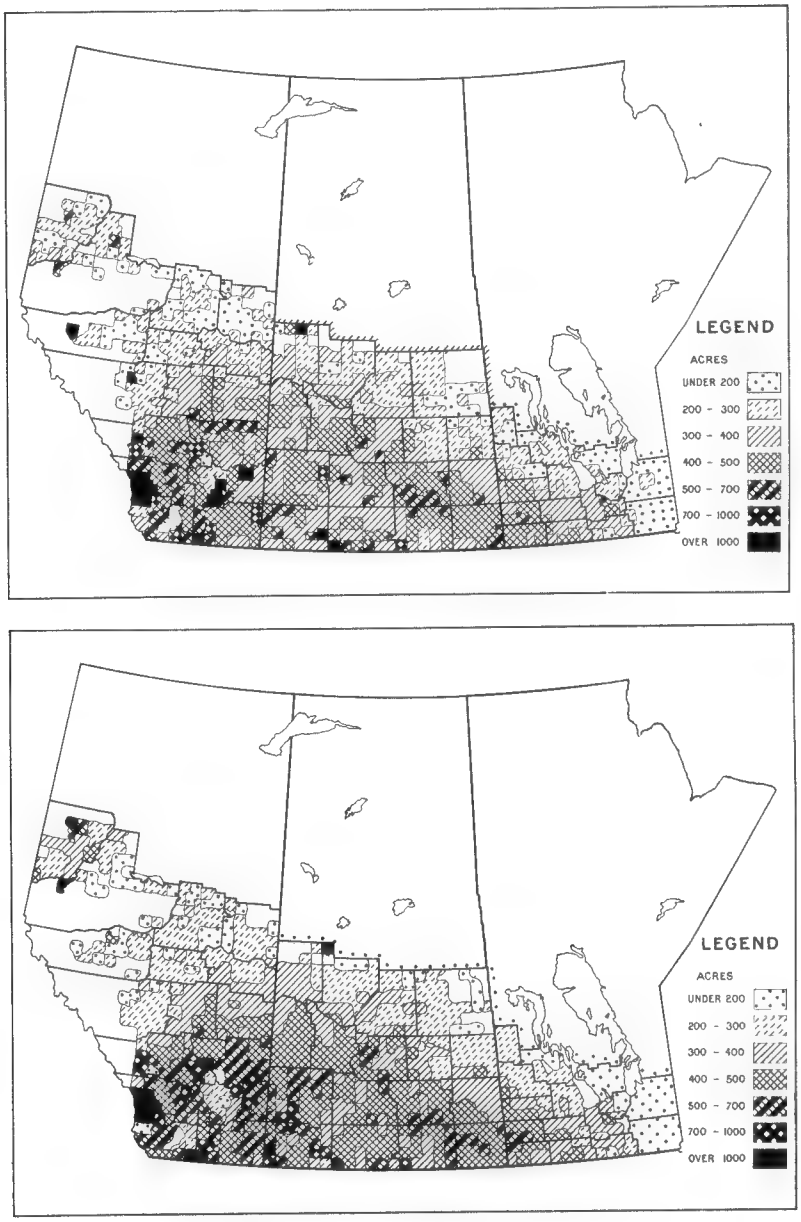


FIG. 70—Percentage of farm acreage abandoned, 1926 (*Statistical Atlas*). The territorial unit is the census division.

Manitoba the season even exceeds 170 days (Fig. 22). This is the average, but deviations from this average are important and sometimes disastrous. The Dominion Department of Agriculture recommends early-maturing varieties of wheat, such as Garnet and Reward, for the whole of the Park Belt except the section in southwestern Manitoba and southeastern Saskatchewan (Fig. 64). Though the Park Belt is definitely a part of the spring wheat region, frost hazard has been one factor among others which has promoted a somewhat greater diversification of agriculture.

The soils of the Park Belt are characteristically black (Fig. 24). The annual rainfall is not sufficient to percolate through the soil



FIGS. 71-72—Mean size of farms in 1921 (above) and 1926 (below) (compiled from the Census of Canada, 1921, and from the Census of Manitoba, Saskatchewan, and Alberta, 1926). The territorial unit is the municipality.

to the "water-table", although the moisture is carried much further down than in the semi-arid region. The zone of lime accumulation occurs at much greater depth than in the semi-arid section (3 feet as compared with 18 inches) (Fig. 67). This depth, however, varies directly with the annual precipitation. Frost in winter and a luxuriant growth of grass in the summer are influences preventing the leaching of valuable mineral salts from the surface

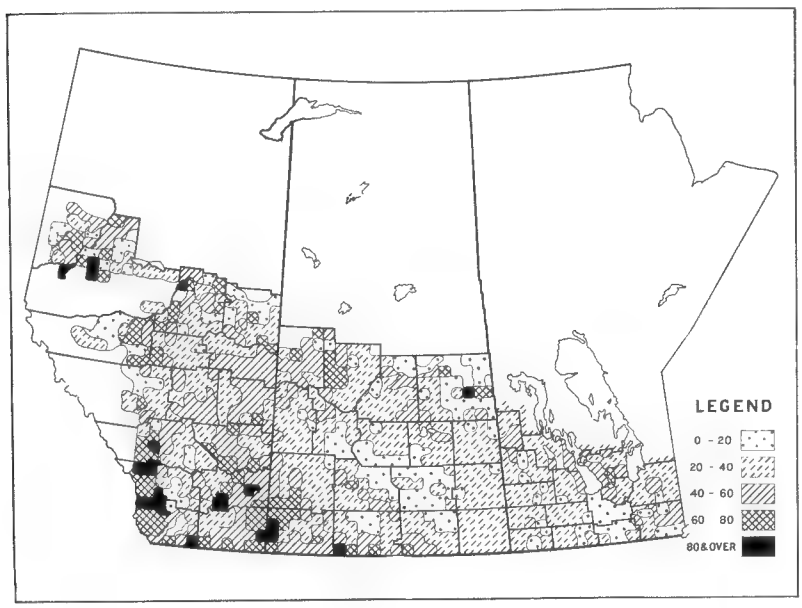
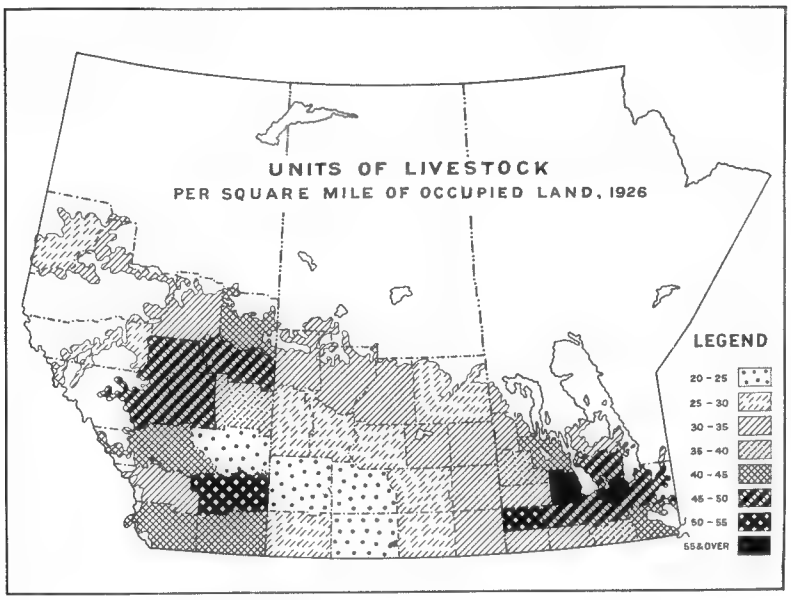
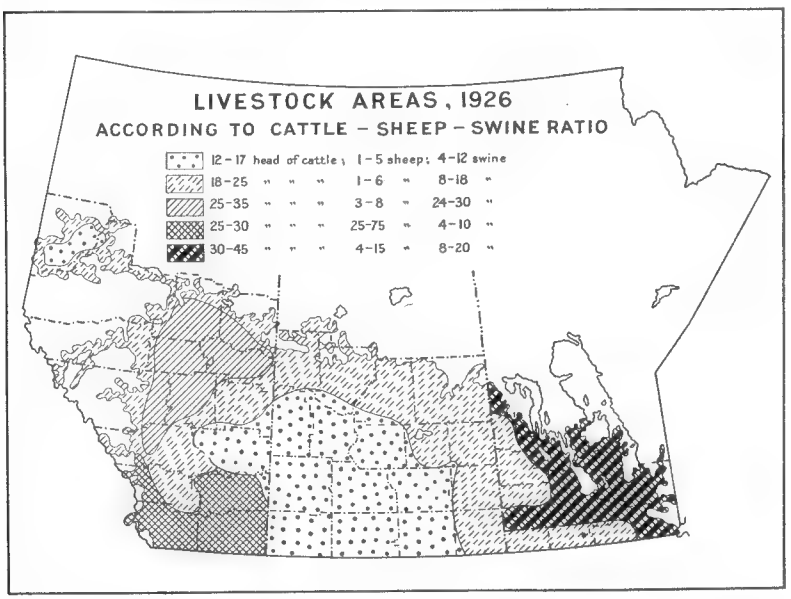


FIG. 73—Percentage of natural pasture to occupied land, 1926 (compiled from the Census of 1926). The territorial unit is the municipality.

layer of soil. Decaying vegetation has given excellent mechanical properties to this soil.

Nitrates, lime, and phosphorus, so important for plant food, are present in great plenty (Table IV). Not only does the surface layer contain more than twice the proportion of nitrogen and phosphorus found in the brown prairie soils, but the surface layer has a much greater depth. Near Edmonton this black surface layer measures twelve inches and more in depth. In the Saskatchewan Park Belt, where the rainfall is lighter, the depth of the black surface layer is somewhat less. In the parkland of the Carrot River valley, where the silty clay loam is a lake deposit,





FIGS. 74 and 75—Units of livestock density per square mile of occupied land, 1926 (compiled from the Census of Manitoba, Saskatchewan, and Alberta, 1926).

One livestock unit equals 1 mature horse or cow, 2 head of cattle under two years old, 5 mature hogs or 10 pigs, 7 ewes or 14 lambs. The territorial unit is the census division. The occupied area is outlined from the township population figures of the Census of 1926.

FIG. 75—Livestock areas, 1926 (compiled from the Census of Manitoba, Saskatchewan, and Alberta, 1926). The territorial unit is the census division. Compare Figs. 76, 77, and 78.

the surface layer is as deep as near Edmonton and the nitrogen content is substantially greater. An estimate has been made by Professor A. H. Joel that the nitrogen present (not all in soluble form) in the upper 6⅔ inches of this soil is sufficient for 261 crops of wheat with an average yield of thirty bushels to the acre.[6]

On the outer margin of the true Park Belt lies a transition area (Figs. 68, 69). Originally parkland, it has been encroached upon by the forest and is in process of being converted in soil, as it has in vegetation, to timber country. The soils of this area retain many of the valuable qualities of the parkland soils, but clearing is sometimes costly.

It is estimated that in the Park Belt in the three provinces there are 19,250,000 acres of land satisfactory for cultivation and about half of this amount marginal for cultivation.[7] Baker estimated 80 per cent. of this belt to be arable,[8] but Newton estimates that 25 per cent. is "not suitable for cultivation".[9] The difference between these estimates is occasioned largely by the inclusion in Baker's estimate of the Red River Valley, where the proportion of arable land is high. Baker estimates that in the whole sub-humid belt in Canada only 33 per cent. of the potentially arable land was in cultivation in 1926.[10] As Newton's estimate shows, however, much of this untilled potential agricultural land is marginal or unsuitable for cultivation under present circumstances. It is significant, however, that, of the abandoned farm acreage in the three Prairie Provinces in 1926, a very small proportion was located in the Park Belt. Whereas in some census districts in the semi-arid prairie zone and in the timber soil areas from 10 to 55 per cent. of the farm acreage was abandoned, no census district wholly within the Park Belt shows abandonment of more than 2½ per cent. of the farm acreage. Since marginal land is likely to be abandoned in times of stress, one infers that up to 1926 comparatively little marginal land in the Park Belt had been occupied, or that, where it was in use, it was combined with better land in a satisfactory farming enterprise.

The Park Belt, like almost the whole of the prairie region, is predominantly a grain-growing area. In no part of it in 1925 did the gross income derived from the sale of animals and animal

[6] Joel, Edmunds, and Mitchell, *op. cit.*, p. 37.
[7] See Appendix, p. 230.
[8] O. E. Baker, "Agricultural Regions of North America: The Spring Wheat Region." *Economic Geography*, Vol. 4 (1928), p 416.
[9] See Appendix, p 228.
[10] Baker, *op. cit.*, p 417.

products exceed 25 per cent. of the total farm income (Figs. 109, 110). Nevertheless, such products are relatively more important in the Park Belt than they are in the prairie country (Figs. 74-78).

The relative importance of wheat varies between wide extremes over the whole area (Fig. 54). In parts of the Manitoba section in 1926, only 20 to 30 per cent. of the total field crop acreage was in wheat, while in the Saskatchewan section some municipalities had over 80 per cent. in wheat. In the Alberta section the proportion ranged from 30 per cent. in the more humid area around Edmonton to more than 70 per cent. as the semi-arid margin was approached. Between 1921 and 1926 the importance of wheat declined sharply in the earliest settled portion of the Park Belt, that lying in Manitoba and in southeastern Saskatchewan, while in the remaining Saskatchewan and Alberta sections its importance increased substantially. This change is associated here as in the Red River Valley mainly with the age of settlement and with the problem of controlling weeds. The area affected has been settled from forty to fifty years.

Barley is a relatively unimportant crop throughout the Park Belt except in the Manitoba and southeastern Saskatchewan sections, where between 1921 and 1926 it increased in importance as wheat decreased, just as it did in the Red River Valley (Fig. 56).

Reference to Figure 74 will show the Park Belt to have a greater density of livestock in proportion to the land occupied than the Prairie Belt generally. The presence of ample supplies of water increases the comparative advantage of livestock. The map shows also that livestock is more important in the Manitoba section and in the Alberta section than in the intervening Saskatchewan section. Nearness to urban markets in Manitoba and greater humidity in Alberta are important factors. West of a line drawn from Calgary to Edmonton and northeast of Edmonton, frost is a factor reducing the amount of wheat grown and increasing the importance of cattle and swine. There is a predominance of swine in the Alberta Park Belt and a predominance of cattle in Manitoba. Barley, oats, and forage crops become relatively more important in these areas (Figs. 54-56).

Farms are, on the average, smaller in the Park Belt than on the open prairie, though larger than in the wooded country. A half-section farm (320 acres) is an average size for the Park Belt, while

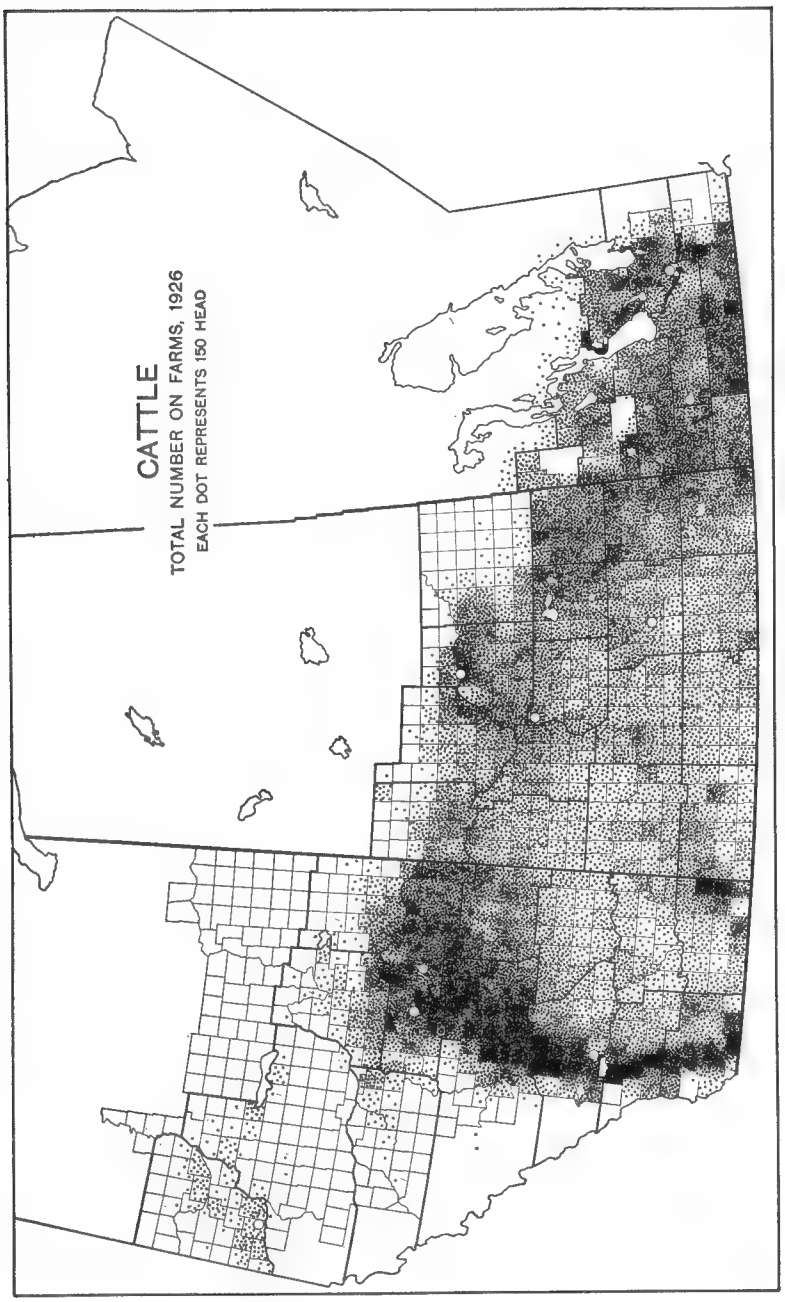


FIG. 76—Distribution of cattle, 1926 (*Statistical Atlas*).

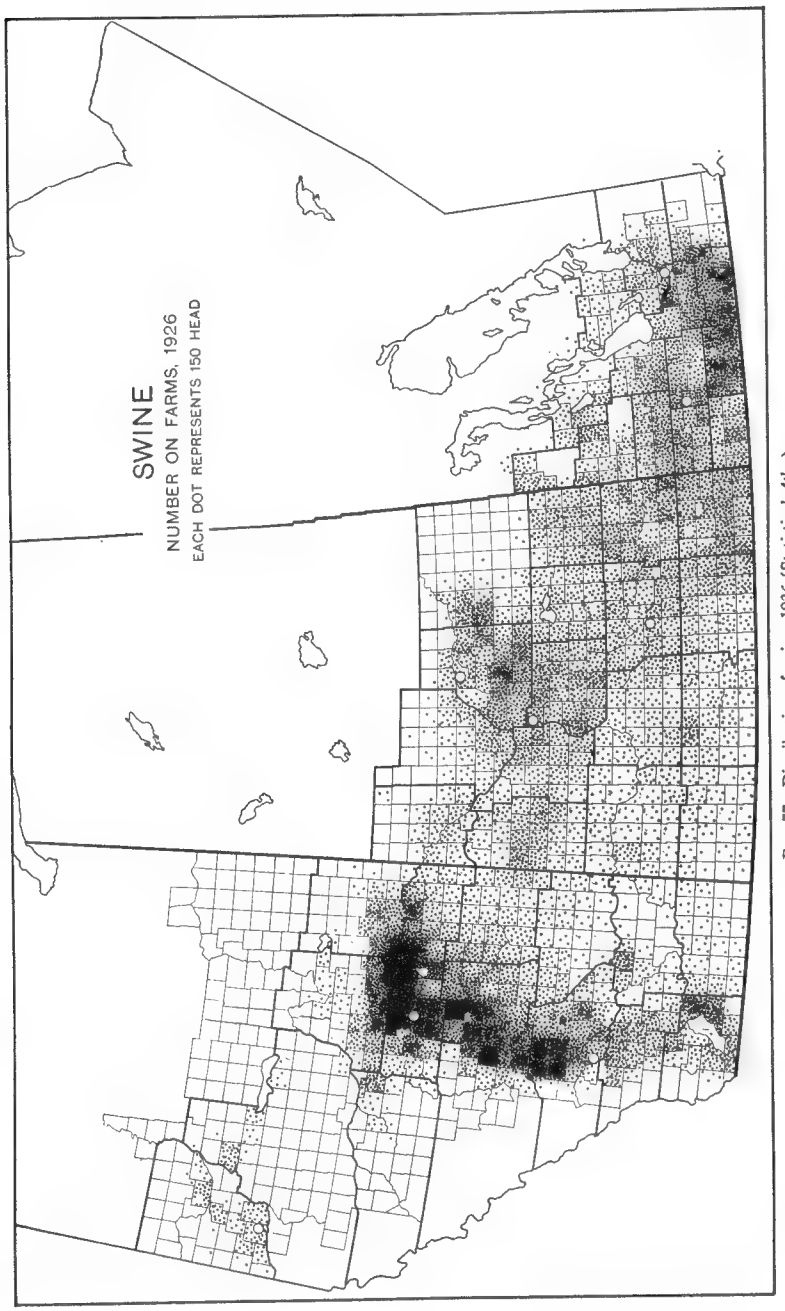


FIG. 77—Distribution of swine, 1926 (*Statistical Atlas*).

on the open prairie the average is three quarter sections, full-section farms being typical (Figs. 71, 72). The size of the average farm is increasing here as in the other sections of the West.

With the exception of the Red River Valley, the Park Belt is the most densely settled area of the western plains. Practically all townships in it have a rural population density of five to ten persons or greater (Fig. 49). A few individual townships fall below this density on account of local inferiorities of soil and

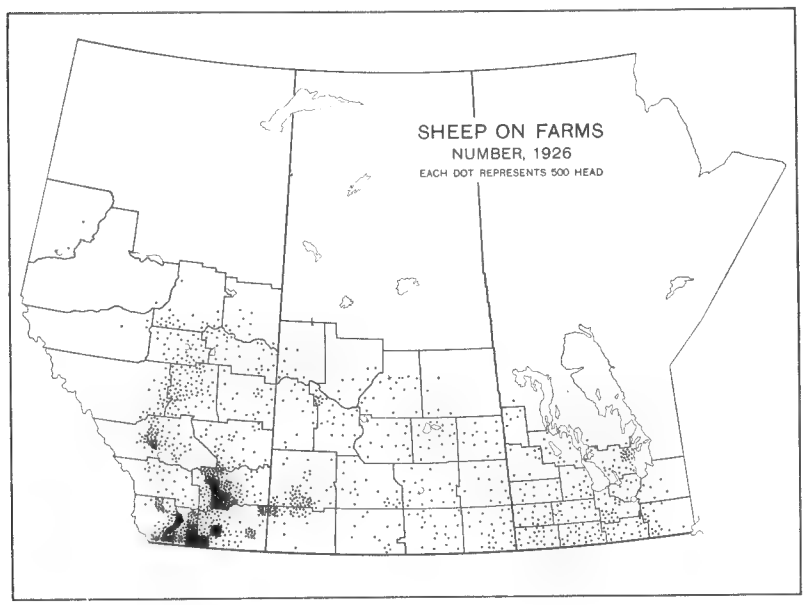


FIG. 78—Distribution of sheep, 1926 (*Statistical Atlas*).

topography. This is true of "islands" such as the sandy Assiniboine delta in Manitoba (not truly a part of the Park Belt), the Beaver Hills, the Touchwood Hills, and other similar places where forest reserves and Indian reserves have been established. Where the Park Belt crosses the Saskatchewan-Alberta boundary, there is a considerable area in which the rural population density falls to the class of two to five persons per square mile. In this area the Park Belt embraces a comparatively narrow strip of territory flanking the North Branch of the Saskatchewan. Topography is broken and the proportion of arable land is correspondingly reduced. Without a detailed topographical map, this can be

inferred from Figure 73 showing the proportion of occupied land in natural pasture. The proportion of occupied land in natural pasture in the municipalities of this area in 1926 ranged from 30 to 80 per cent.

It has already been pointed out that population densities exceeding ten persons per square mile in the Canadian West are usually associated with settlements of non-Anglo-Saxon peoples, particu-

Fig. 79—Aerial view of Park Belt settlement near Red Deer, Alberta (Royal Canadian Air Force).

larly of those from Central and Eastern Europe. These settlements are particularly numerous in the Park Belt and in the wooded country which encircles it (Fig. 58). In these settlements, as contrasted with those of British, French, or United States origin, farm holdings are smaller, the number of livestock, particularly cattle and swine, is proportionately greater, and farming is generally more diversified. There is a temptation to explain this as a transference of an Old World type of agriculture to a new country, and in part this may be so. These settlers came to the country at a time when the available free land was mainly in the Park Belt or the wooded margin of the Park Belt. Bringing with them little

capital but a willingness to undertake heavy manual labour not always characteristic of Canadian and United States settlers, they settled in areas requiring clearing and have followed the type of agriculture suited to the localities in which they settled.[11]

Since the sizes of farms throughout this zone is increasing as in other areas, it is unlikely that the density of rural population here will increase greatly, except in the foreign-language settlements. On the other hand, population decreases in the Park Belt between 1921 and 1926 and between 1926 and 1931 were confined to small areas (Figs. 51, 53).

[11] *Agriculture, Climate, and Population of the Prairie Provinces of Canada, A Statistical Atlas Showing Past Development and Present Conditions.* Prepared under the direction of W. B. Hurd and T. W. Grindley (Ottawa: Dominion Bureau of Statistics, 1931), p. 86.

CHAPTER VI

THE PRAIRIE PLAINS

ALONG a boundary marked by 15 inches of precipitation in the south and 14 inches in the north, parkland vegetation and soils give way to prairie vegetation and soils (Figs. 16, 23, 24). The "bluffs" or patches of woodland disappear; tall grass is replaced by short grass; black park soils are supplanted by chocolate brown soils; topography on the whole tends to become more rolling.

The controlling features of the Prairie Plains change as one moves from the sub-humid to the almost arid centre where the warm-season rainfall is less than seven inches. This centre is broken into two areas by the influence of the Cypress Hills (Fig. 17). To the south, one area extends along the international boundary to embrace a small corner of Saskatchewan and the Milk River Ridge in Alberta; to the north a larger 8-shaped area extends from the junction of the Bow and Oldman Rivers to the junction of the Red Deer and the South Saskatchewan.

An outer margin of the prairie zone from 40 to 60 miles wide, bordering the sub-humid Park Belt, has characteristic dark brown soils (Fig. 24). The layer of lime accumulation is about 12 to 15 inches below the surface. Soil of this type in the Rosetown district of Saskatchewan (Fig. 80) near the semi-arid boundary of this zone, is thus described in a soil survey report:

> The most outstanding features of these normal profiles are the brown to dark brown surface soils and the light grey layer of lime carbonate accumulation beginning usually at depths of from eight to twelve inches from the surface. There is usually a very thin layer of loose soil on the surface, underlain by a harder, heavier zone which breaks into long, or columnar-shaped lumps on drying. The brown surface colour and the lime carbonate zone are the products principally of a prairie type of vegetation and of a limited supply of effective soil moisture. The quantity of moisture has been sufficient to permit the accumulation of organic matter from a fairly abundant growth of short and medium grasses; and of such quantity as to permit an average annual penetration to depth represented by the lime carbonate zone.[1]

From the circumference to the centre of the semi-arid prairie

[1] *Soil Survey of the Rosetown Area* (Saskatoon . University of Saskatchewan, College of Agriculture Soil Survey Report No. 6, 1927), pp. 11-12.

lands the surface soil grows lighter in colour. Dark brown at the circumference, it becomes greyish brown in the dry centre. The surface layer varies from four to twelve inches in depth. The zone of lime accumulation is near the surface (Fig. 84). These soils are sometimes deficient in organic matter and nitrogen, and they nearly always contain less organic matter than the dark brown and black park soils. The following table compares brown prairie soil at Medicine Hat with black park soil at Edmonton and typical soils of the humid sections of the continent.

TABLE IV—CHEMICAL COMPOSITION OF SEVERAL NORTH AMERICAN SURFACE SOILS.*

	NITROGEN (per cent.)	PHOSPHORUS (per cent.)	CALCIUM (per cent)	MAGNESIUM (per cent.)	POTASSIUM (per cent)
Medicine Hat Sheet, Alberta, Loam	147	045	65	38	1 45
Edmonton, Alberta, Loam. .	620	.108	1 22	62	1 49
Guelph, Ontario, Loam...	181	097	1 39	40	1 66
Illinois, U.S.A., Brown Silt Loam	247	054	. .	. .	1 78

* F. A. Wyatt and J. D. Newton, *Soil Survey Report of Medicine Hat Sheet* (Edmonton University of Alberta, College of Agriculture Bulletin No.14, 1926), p 39.

Most of the soils of the Prairie Plains are of medium to heavy texture, and carry moisture from one season to another. Though heavier to till, the medium and heavy soils are the more valuable because of their drought-resisting qualities. Sandy soils are, however, frequent in occurrence, and sand dunes are a more important barrier to settlement in the Prairie Belt than in any other (Figs. 24 and 87).

A type of soil which is not limited to the Prairie Plains but which occurs more frequently in that zone than in others, is the "blow-out" or "burnt-out" loam. Such soil is characterized by "numerous shallow depressions or 'blow-out spots', varying in depth from about six inches to about eighteen inches, irregular in shape, but varying in diameter from about five feet to about fifteen feet or more"[2] (Fig. 86). The surface soil (Fig. 85) in these

[2] Wyatt and Newton, *op. cit.*, p. 31.

depressions is a fine impervious clay loam which supports very scanty vegetation. In some cases the depressions are quite bare. Where the "blow-out spots" are numerous, cultivation is difficult and crop yields very low. Where they are few in number they become filled in by cultivation and disappear. Originally thought by the settlers to be spots where the sod had been burnt off by prairie fires, they are more correctly explained as depressions in which accumulating alkali salts have hindered the growth of grass and allowed the surface soil to blow out.

In three areas (16,000,000 acres) in the brown soil zone along the southern part of the Alberta-Saskatchewan boundary, 1,500,000 acres of land or nearly 10 per cent. were classed as "blow-out loam".[3]

Topography is rougher and eroded land more frequent in occurence in the Prairie Plains than in other zones. The scanty vegetation of short grass, which is particularly scanty on the north banks of the eastward-flowing rivers, is insufficient to hold the soil, and "breaks" and "coulées" extend back from the river valleys. Such eroded areas are unsuited to cultivation. In the Medicine Hat district, which is traversed by the South Saskatchewan River and its tributary, the Bow, approximately 8 per cent. of the land is classed as eroded.[4] In addition to the rough land along river banks, old eroded plateaus such as Wood Mountain and the Cypress Hills are too rough for cultivation.

In southwestern Saskatchewan and southeastern Alberta, stretching north from the international boundary to about the fifty-first parallel, and divided into two sections by the Cypress Hills, lies the almost arid centre of the Prairie Plains. Here the short grass becomes sparse, and sage and cactus appear on the lighter soils (Fig. 90), and the proportion of land occupied in the northern part falls to less than 20 per cent. (Fig. 41). In the southern part the greater importance of grazing raises this percentage somewhat.

Irrigation has been an important factor in this and neighbouring sections of the country (Fig. 94). The first large irrigation project was that of the Alberta Railway and Irrigation Company (1899) in the district south of Lethbridge colonized mainly by Mormon settlers from Utah. This project was later taken over by the Canadian Pacific Railway and operated as a Lethbridge

[3] See Appendix, pp 226, 227, 229.

[4] Wyatt and Newton, *op. cit*, p. 23.

Section. In addition, the Canadian Pacific Railway has constructed immense irrigation works on the north side of the Bow River between Calgary and Medicine Hat. Work on these was begun in 1904 and completed after the outbreak of the World War. These projects of the Canadian Pacific Railway were made possible by the grant to it of 3,000,000 acres of land along its main line east of Calgary. This land was accepted by the railway

TABLE V—MAJOR IRRIGATION WORKS IN OPERATION IN ALBERTA.*

PROJECT	SOURCE	LENGTH OF CANALS (miles)	IRRIGABLE AREA (acres)	AREA IRRIGATED IN 1930 (acres)
C.P.R. Western Section.....	Bow River.....	1,472	218,980	41,570
C.P.R. Eastern Section.....	Bow River.....	2,500	400,000	89,913
C.P.R. Lethbridge Section. .	St. Mary River.	196	89,000	67,004
Canada Land & Irrigation Co..	Bow River.....	430	130,000	26,470
Taber Irrigation District.....	St. Mary River.	96	21,499	19,322
Lethbridge Northern Irrigation District.....	Oldman River.	573	100,774	70,007
United Irrigation District....	Belly River....	175	34,235	5,847
New West Irrigation District..	Bow River. ...	22	4,501	3,214
Magrath Irrigation District...	St. Mary River.	90	6,975	5,161
Raymond Irrigation District...	St. Mary River.	15	15,129	7,000
		5,569	1,021,093	335,508

* *Canada Year Book, 1932* (Ottawa Dominion Bureau of Statistics, 1933), p. 1067.

in lieu of other land subsidies. The Irrigation Districts Act of Alberta provides for the formation of irrigation districts and the raising of loans for carrying out irrigation projects. It will be noted in Table V that about one-third of the area irrigated in 1930 was in such irrigation districts. In addition to the projects just listed there are more than 300 small privately-owned projects with a total irrigable area of 56,000 acres.

A striking feature of Table V is the relatively small proportion of the irrigable land actually irrigated in 1930. This averaged one-third over all the irrigable areas, but in the northern districts between Calgary and Medicine Hat it was only about one-fifth. In part this is occasioned by the quantity of land which the Canadian Pacific Railway has not yet succeeded in selling, and

in part by the fact that spring wheat is still the chief crop in these districts and farmers try to avoid irrigation if the rainfall is at all adequate. Over much of the irrigable area precipitation is in many years adequate for dry farming. The irrigation ditch is a guarantee against drought rather than a regular aid to farming.

Several other irrigation projects have been investigated but up to the present not put into operation. Though it is estimated that

TABLE VI—UNDEVELOPED IRRIGATION PROJECTS IN ALBERTA AND SASKATCHEWAN.*

			Irrigable Area (acres)
North Saskatchewan Diversion Project	Saskatchewan	915,000	
	Alberta	485,000	
			1,400,000
Lethbridge Southeastern Project			350,000
Medicine Hat Southern Project			7,000
Medicine Hat Eastern Project			4,000
Macleod and South Macleod Project			50,000
Retlaw-Lomond Project			64,184
Champion Project			52,435
Granum Project			4,472
Crow's Nest Pass District Project			30,400
Total			1,962,491

* Information supplied by Director of Water Resources, Alberta.

nearly 2,000,000 additional acres of land are irrigable (Table VI) it does not follow that the projects are all economically sound.

In large measure, the obstacles to agriculture based on irrigation are not engineering obstacles but economic obstacles. Irrigated land must produce a relatively high income per acre if the enterprise is to succeed, but the products of the irrigated sections of Alberta are still chiefly the products of extensive agriculture, producing low incomes per acre. To some degree fodder crops (Fig. 95) for the winter feeding of cattle have been substituted for wheat, but wheat remains dominant. In the Lethbridge area sugar-beet cultivation has made some progress, but the industry is wholly dependent on a relatively high protective tariff. Markets in general are lacking for the products of truck farming which might yield the necessary high income per acre. Further, if high incomes per acre are to be developed there must

be a heavy expenditure of labour. The preparation of the land for irrigation is expensive and laborious, as is likewise the cultivation of such desirable crops as sugar-beets. The high proportion of labour used is likely to continue to be a substantial barrier to the profitable extension of agriculture on irrigated land (Fig. 98).

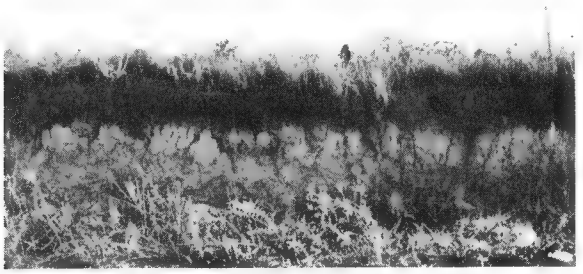


FIG. 80—Profile of dark brown prairie soil. Note the dark surface soil and layer of lime accumulation immediately below. (Saskatchewan Soil Surveys.)

FIG. 81—Looking across the dark brown prairie soil zone toward the Missouri Coteau (Saskatchewan Soil Surveys).

Baker concludes that, while of the semi-arid plains of the United States only 45 per cent. of the land is fit for cultivation, 70 per cent. of the comparable Canadian section is to be classed as arable.[5] It is estimated that nearly half the land in the United States section is too rough and broken for cultivation. An estimate by J. D. Newton gives a more detailed picture. Of 64,000,000 acres of land in the semi-arid (Prairie Plains) belt 15,560,000 acres

[5] O. E. Baker, "Agricultural Regions of North America. The Spring Wheat Region," *Economic Geography*, Vol. 4 (1928), p. 417.

(24 per cent.) are considered not suitable for cultivation. A slightly larger area, 16,890,000 acres, is classed as "marginal". The remainder, 31,550,000 acres, is classed as suitable for cultivation. In this estimate the lands not suitable for cultivation are made up of sands, hilly loams, eroded areas, and alkali areas.[6] It should be noted that in defining land "not suitable for cultivation" no account is taken of lack of moisture, but only of the character of the topography and soil.

The Prairie Plains constitute a highly specialized spring wheat growing section. The dominant limitation on agriculture is the

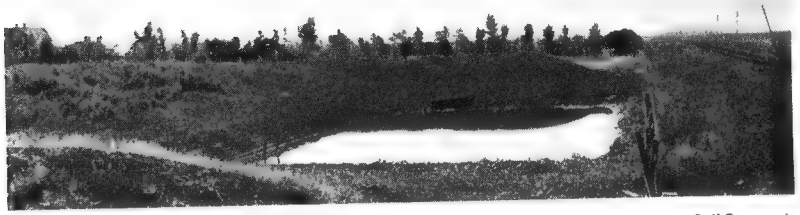
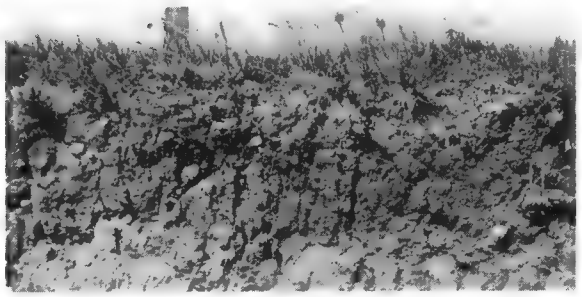


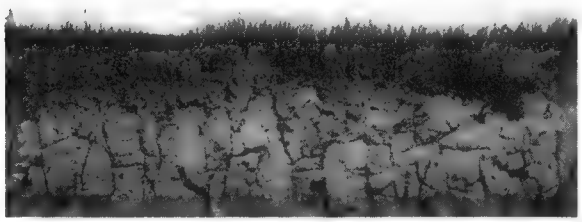
FIG. 82—A "dug-out" for storing water in the heavy clay near Moose Jaw (Saskatchewan Soil Surveys).

deficiency of rainfall, and the comparative advantage lies with drought-resisting crops, of which wheat is by far the most important. In the most arid districts even wheat, unassisted by irrigation, becomes so precarious a crop that grazing, dependent on the drought-resistant native grasses, replaces wheat growing.

The proportion of the total land area occupied in the Prairie Plains varies from more than 70 per cent. in the dark brown soil belt to less than 20 per cent. in the most arid district (Fig. 41). Similarly, the proportion of improved to total land area declines from the sub-humid margin to the centre (Fig. 42). Figure 73 shows the high proportion of natural pasture (unimproved grassland) which characterizes the "dry belt". The proportion of occupied land in field crops ranges from 50 per cent. at the margin to 10 per cent. at the centre.

[6] See Appendix, pp. 226-230, 232.





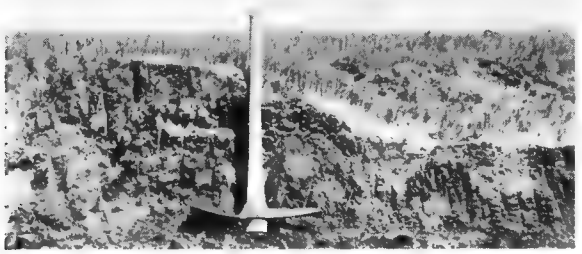


FIG. 83—Profile of brown prairie soil. The brown surface soil is 12 inches in depth. The layer of lime accumulation below is about 11 inches. (Alberta Soil Surveys.)

FIG. 84—Another brown prairie soil profile. Note nearness to the surface of the lime layer. (Saskatchewan Soil Surveys.)

FIG. 85—"Blow-out" soil profile. Note the depression at the right from which the surface soil is gone. (Alberta Soil Surveys.)

Wheat growing competes with grazing in the semi-arid plains. In 1926, in nearly every part of this zone, over 70 per cent. of the cropped land was in wheat (Fig. 54). In more than a third of the zone 80 to 90 per cent. of the field crop acreage was devoted to wheat. Only in a few rough areas and in irrigated districts did the percentage fall below 70. It is readily seen that specialization in wheat is more pronounced near the centre than near the margin of this semi-arid zone. It must be borne in mind, of course, that this means only that of the land sown to crops a larger proportion is sown to wheat. A larger proportion of the semi-arid land is in natural pasture (Fig. 73) or unoccupied (Fig. 41) than in the sub-humid zone. This is reflected in the dot map showing wheat acreage (Fig. 102). Though wheat is relatively more important

in the "dry belt" than in other areas, it is absolutely less important.

Comparison of conditions in 1926 with those in 1921 shows wheat to be becoming relatively *more* rather than *less* important among the field crops of the semi-arid zone. Yet the acreage under wheat did not increase in the drier districts; it decreased sharply (Fig. 104). Wheat was not supplanted by other field crops but by grazing and the abandoned farm.

Oats is a relatively unimportant crop in the semi-arid zone. Over most of the area less than 20 per cent. of the field crop acre-

FIG. 86—"Blow-out" area in southern Alberta. Note depressions and irregularity of the vegetation. (Alberta Soil Surveys.)

age is devoted to oats. In considerable areas oats account for less than 10 per cent. of the acreage (Fig. 55). Oats in this belt are grown almost solely as horse-feed, and the horse has retreated before the tractor.

Barley is not grown to a significant degree in the semi-arid zone (Fig. 56) but autumn rye is of some importance, particularly in the drier areas, where in a few districts 20 to 30 per cent. of the crop acreage may be sown to rye.

Ranching in the semi-arid zone utilizes the rough land adjacent to the rivers (Fig. 92) and the more humid elevations such as the Cypress Hills and Wood Mountain. Figure 105, showing the location of Crown grazing leases, defines fairly accurately the ranching districts, although, of course, a great many ranches are located on privately-owned land. The areas are grouped in three

FIG. 87.—A part of the great sand hills near Swift Current, Saskatchewan (Saskatchewan Soil Survey).

classes: (1) The long-grass ranges or grazing lands are found among the foothills of Alberta (Fig. 13) and in the Cypress Hills where the climate is sub-humid. (2) The medium grass country includes the lesser elevations of the semi-arid zone, the Milk River ridge, Wood Mountain, and the adjacent Willow Bunch ranges, the Johnstone Lake ranges and others in the hilly districts near the Missouri Coteau (Fig. 106). (3) The short grass plains include the centre of the Canadian "dry belt" stretching north about 150 miles from the Montana boundary (Fig. 108).[7] Summer grazing is found on the open plains, but winter grazing is confined to the river banks, coulées, and other broken areas where topography affords some protection against storms. It is possible for cattle to graze on these ranges all winter. The chinook winds prevent heavy accumulations of snow, and the native grasses, which cure on the stem in the dry summer, provide excellent grazing. In severe winters, of course, grazing must be supplemented by winter feeding. Climate and topography favour ranching in these areas. Land, cheap because moisture is inadequate for other purposes or because the topography is too broken for machine agriculture, mild winters with light snowfall and cold spells of short duration, a highly nutritious native drought-resistant vegetation—these combine to create a comparative advantage in favour of ranching. Where the topography is level, however, the competition of wheat growing is severe, and the overcrowding of ranges has destroyed much of the cover of native grass.

As one moves from the sub-humid margin on the Saskatchewan side to the more arid centre, the number of livestock per square mile of occupied land at first decreases and then increases as the driest zone is reached (Fig. 74). On the west the transition from the sub-humid to almost arid conditions is so rapid that the intervening area of low livestock density is eliminated. In the grazing area cattle are about as numerous in proportion to the land occupied as in the Park Belt, swine are less numerous and sheep much more numerous (Fig. 75).

In spite of the existence of an area in the semi-arid zone which has been designated as a "grazing and irrigated crops region"[8]—an area in which grazing actually is of more importance than in most other areas—one must not lose sight of the fact that even

[7] *Report of Dominion Field Husbandman, 1926* (Ottawa. Department of Agriculture, 1927), p. 33.
[8] Baker, *op. cit.*, p. 400.

in this, the most arid district of Western Canada, field crops (almost wholly wheat) represented more than 70 per cent. of the total value of farm products in 1925. In approximately half of the semi-arid zone the value of field crops constituted over 90 per cent. of the total value of farm products (Figs. 109, 110).

The average farm on the Prairie Plains is larger than in the Park Belt (Fig. 72). Over the whole area the average farm is three quarter sections (480 acres). In southwestern Saskatchewan and southern Alberta the average in many municipalities is a section or more. A striking exception is found in the irrigated districts near Lethbridge and between Medicine Hat and Calgary, where quarter-section farms are common. Between 1921 and 1926 the average size of farms increased (Figs. 71, 72). In most of the municipalities in the brown soil zone the average increased by 100 acres.

Such averages, however, obscure the much larger size of the more prosperous and representative farms. The many farms two to four or five sections in size are counterbalanced by the still greater number of small holdings. The larger farm is definitely on the increase. In view of the lower yields of the semi-arid belt, the profitable farm enterprise is one which works large areas of cheap land quickly and cheaply by means of machinery. The semi-arid belt is the natural territory of the large farm. Baker notes that farms on the average are larger in the United States section of the semi-arid zone than in the Canadian section, the average for the United States portion being 590 acres, as compared with 440 acres in the Canadian section.[9] The explanation of this difference lies in part in the greater extent of the arid margin in the United States, in part in the greater proportion of rough land, and in part in the greater maturity of the United States settlements. Since the World War the acreage per farm has been increasing in the Canadian section but not in the United States section.[10]

The semi-arid Prairie Plains with their greater proportion of unoccupied land, their greater areas of natural pasture, and their larger farms, support a lower density of population than does the Park Belt (Fig. 49). Throughout the whole area only isolated townships have a rural population density of more than ten per square mile, with the exception of the irrigated districts of southern

[9] *Op. cit.*, p. 427.
[10] *Ibid.*, p. 426-7.

FIG. 88—Dry lake-bed in the semi-arid belt. Note the alkali salts. (Alberta Soil Surveys.)
FIG. 89—A level phase of the semi-arid prairie in Alberta (Alberta Soil Surveys).
FIG. 90—Hilly phase of the Prairie Plains, in this case glacial moraines (Alberta Soil Surveys).

Alberta and the German settlements south of Swift Current and northeast of Maple Creek. The dark brown soil area (Fig. 24) has predominantly a rural population density of from two to five persons per square mile, although along the sub-humid margin "tongues" of greater density extend into the dark brown soil zone. In a brown soil area in southern Saskatchewan, between longitudes 105° and 108°, there is a population density greater

FIG. 91—Eroded country in the semi-arid section of the third prairie level (Alberta Soil Surveys).

than "normal" for the zone. It will be noted that it is associated with annual and seasonal rainfall higher than characterize the surrounding areas (Figs. 16, 17).

The greater part of the brown soil triangle of the Prairie Plains has a rural population density of less than two to the square mile, though there are important exceptions along the northwest side of the triangle. In the main the isopleth of two persons per square mile falls in country having between eight and nine inches warm-season rainfall (Fig. 17). Two exceptions may be noted. The greater humidity of the country around the Cypress Hills is offset by the rough topography and inferior soil. In a considerable area along the Alberta-Saskatchewan boundary between latitude 50°

and 51°, a Russian-German population (Fig. 58) has achieved a density of more than five per square mile.

Comparison of the population density maps for 1921 and 1926 (Figs. 47, 48) shows that between these years a great change took place. The area of low population density in southeastern Alberta was greatly enlarged. This was particularly marked in the area north of the main line of the Canadian Pacific Railway from

FIG. 92—Rough land in the valley of the South Saskatchewan north of Swift Current; looking north from the escarpment toward the river, which can be seen in the left background. Note the trees and scrub on the northward-sloping side of the valley. (Saskatchewan Soil Surveys.)

Medicine Hat to Calgary, where upwards of two thousand square miles were added to this "internal frontier". A similar movement continued after 1926, though more slowly; the map for 1931 (Fig. 49) records a further extension of fringe densities northward almost to the margin of the dark brown soil belt.

More direct records of the same phenomena are found in the map showing the percentage of farm acreage abandoned (Fig. 70), and decreases in population (Figs. 51, 53). In Census District No. 3 in Alberta, which extends north from Medicine Hat, fifty-five per cent. of the farm acreage was abandoned. In Census

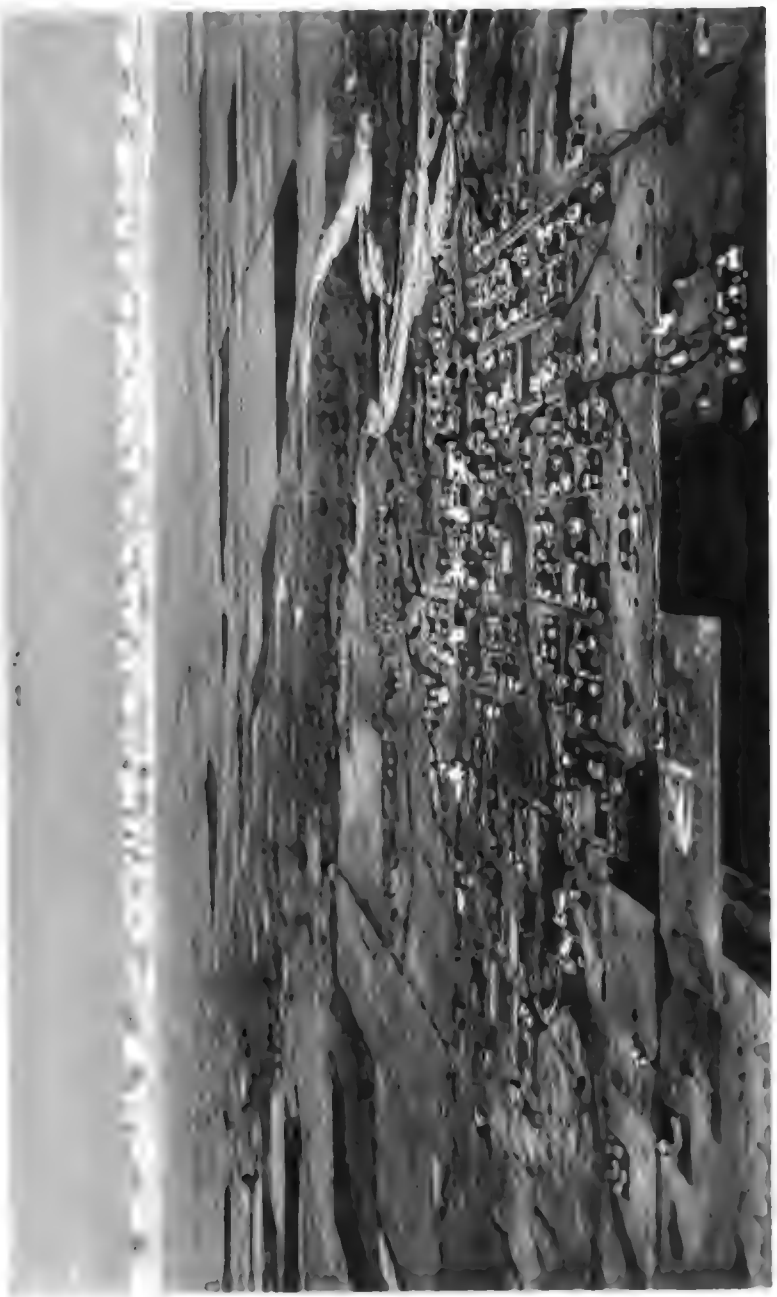


Fig. 93—Looking west over the town of High River, Alberta (30 miles south of Calgary), toward the Rocky Mountains (Royal Canadian Air Force).

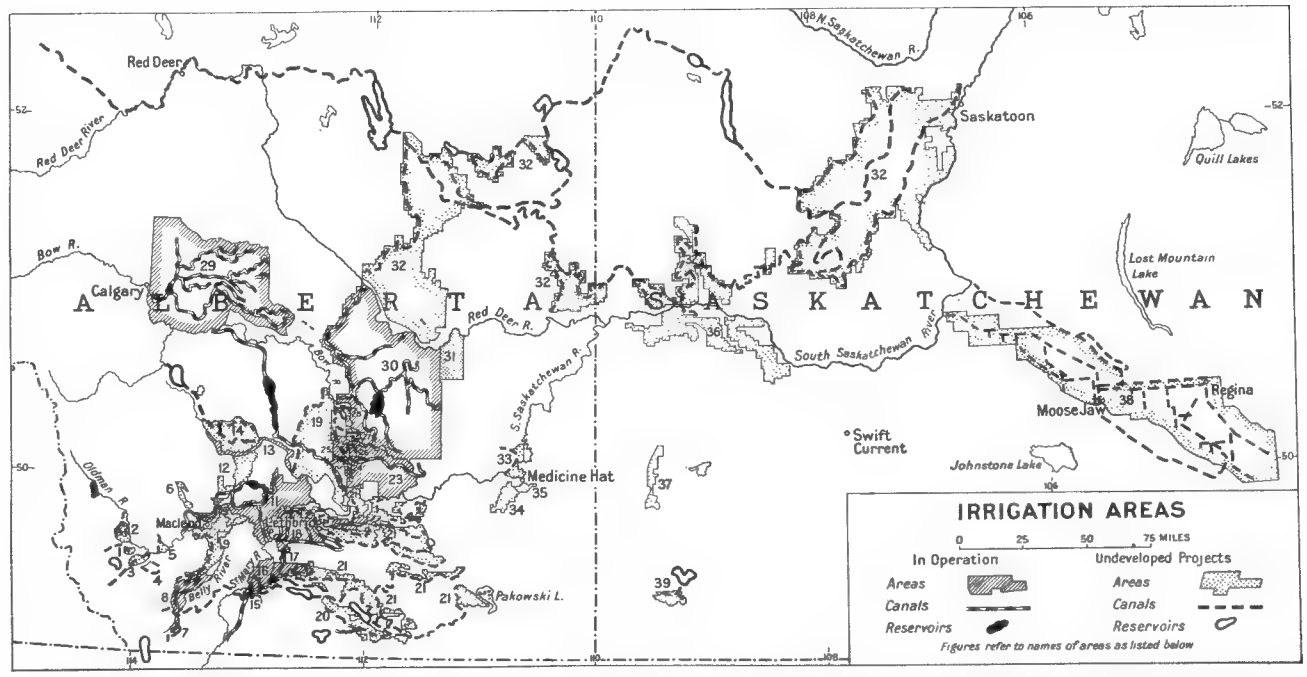


FIG. 94—Irrigation projects in the Prairie Provinces (based on manuscript map provided by Dominion Water Power and Reclamation Service, Department of the Interior, Ottawa). Key to names of projects: 1, Cowley; 2, Todd Creek; 3, Pincher Creek North; 4, Pincher Creek East; 5, Beaver Creek; 6, Granum; 7, Mountain View; 8, United District; 9, South MacLeod; 10, Pierce-Orton; 11, Lethbridge Northern Irrigation District; 12, Barous-Carmangay; 13, Little Bow Irrigation District; 14, Highwood River; 15, Magrath South; 16, Magrath District; 17, Raymond District; 18, C.P.R. Lethbridge Section A.R. & I. Co.; 19, Retlaw-Lomond; 20, Warner; 21, Lethbridge South Eastern; 22, Taber District; 23, Canada Land and Irrigation Co.; 24, Retlaw South; 25, Retlaw North; 26, New West; 27, River Bow; 28, Eyremore; 29, C.P.R. Western Section; 30, C.P.R. Eastern Section; 31, Tide Lake; 32, North Saskatchewan; 33, Redcliffe; 34, Medicine Hat Southern; 35, Medicine Hat Eastern; 36, Leader-Cabri; 37, Maple Creek Valley; 38, South Saskatchewan Water Supply Project; 39, Roberts-Vidora.

FIG. 95—Flooding alfalfa land in the C.P.R. Eastern Irrigation Project (Canadian Pacific Railway).
FIG. 96—Irrigating root crops in southern Alberta (Canadian Pacific Railway).

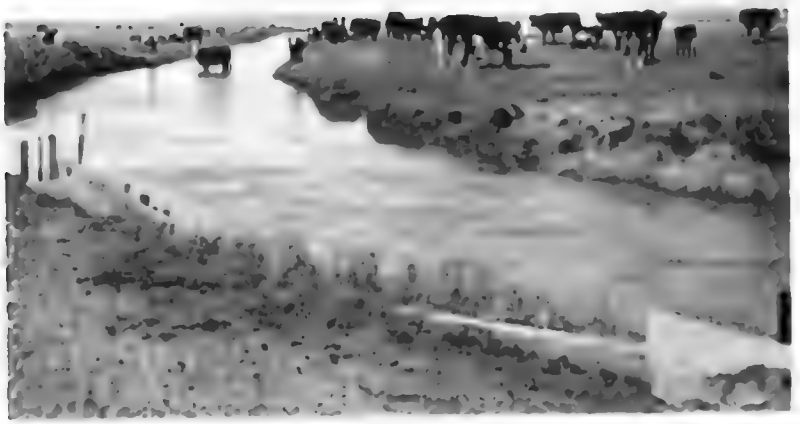


FIG. 97—Pasturel and along an irrigation ditch (Canadian Pacific Railway).

FIG. 98—Galicians hoeing sugar-beets in the irrigated country near Lethbridge, Alberta. Native Canadian male labour prefers the extensive machine agriculture. (Canadian Pacific Railway.)

Districts Nos. 1, 3, and 5, which include most of the evacuated zone, 36.5 per cent. of the farms were abandoned. Table VII shows the degree to which it was the small farms that were abandoned. In part, the predominance of the small farm in this movement is a reflection of its uneconomic size, in part it reflects the last act in the history of the unsuccessful farmer, who has been unable to accumulate sufficient capital to enlarge his farm (Fig. 112).

TABLE VII—ABANDONED FARMS, ALBERTA, 1926*.
CENSUS DISTRICTS Nos. 1, 3, AND 5.

	160 ACRES AND UNDER		161 - 480 ACRES		481 ACRES AND OVER	
	No.	acres	No.	acres	No.	acres
Abandoned Farms...	3650	582,112	2613	850,223	197	172,426
Occupied Farms....	2105	314,934	5604	2,016,786	3505	3,604,600
Percentage abandoned	63 4		31 8		5 3	
Percentage of acreage abandoned .. .		64.9		29 7		4 6

* Compiled from Census of Alberta, 1926.

Decreases in rural population in this area are the joint product of the abandoning of farms and the increasing size of farms. Some farms have been abandoned, some have been purchased or rented by a neighbour.

The retreat of settlement in southern Alberta is evidence that much marginal land was settled in this area and also that the average farming practice was inadequate to cope with the difficult problem of scanty precipitation. Rainfall is light in this area, but, even more important, evaporation is heavy. Wyatt and Newton describe the problem in the Medicine Hat area thus:

> By carefully controlled experiments it has been found that growing plants utilize a surprisingly large amount of water. The amount utilized varies with the kind of crop and the growing conditions. The average of many determinations and many crops is over 400 pounds of water for each pound of dry matter. The water must pass from the soil into the plant roots and out through the leaves. This quantity of water thus transpired for each pound of dry matter produced is known as the transpiration ratio. Using this figure and a given weight for a given crop we can calculate roughly how much water would be transpired by that crop. Thus, for example, a thirty-bushel crop of wheat,

including grain and straw, would contain at least 5,000 pounds of dry matter, and require 1,000 tons or about 9 acre-inches of water. There are additional losses of water from soil caused by evaporation and run-off. These added losses would bring the above figures somewhat higher.

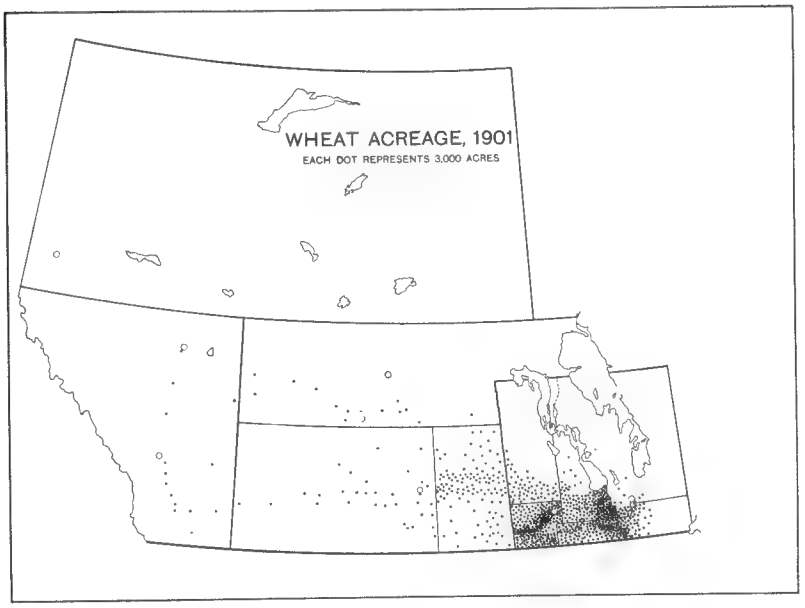
It has been shown that, under actual farming conditions in southern Alberta the wheat crop has required, not 400 pounds of water, but about 1,700 pounds of water to produce one pound of dry matter, or twice this amount to produce one pound of grain and one pound of straw, and the farmer has received only about 1.1 bushels of wheat for each inch of rainfall. It would thus seem that the utmost effort should be made towards greater efficiency in the use of our rainfall. Considerable losses due to evaporation and run-off are unavoidable, but better rotations and soil management would materially reduce moisture losses. The margin of precipitation over actual crop needs throughout the areas surveyed is small during the average season. The average annual precipitation is about 11.3 inches, and since it often drops below this amount it is not strange that the summer fallow must be resorted to. However, the fallow must be better managed than in the past if we are to expect the most efficient use of the rainfall.

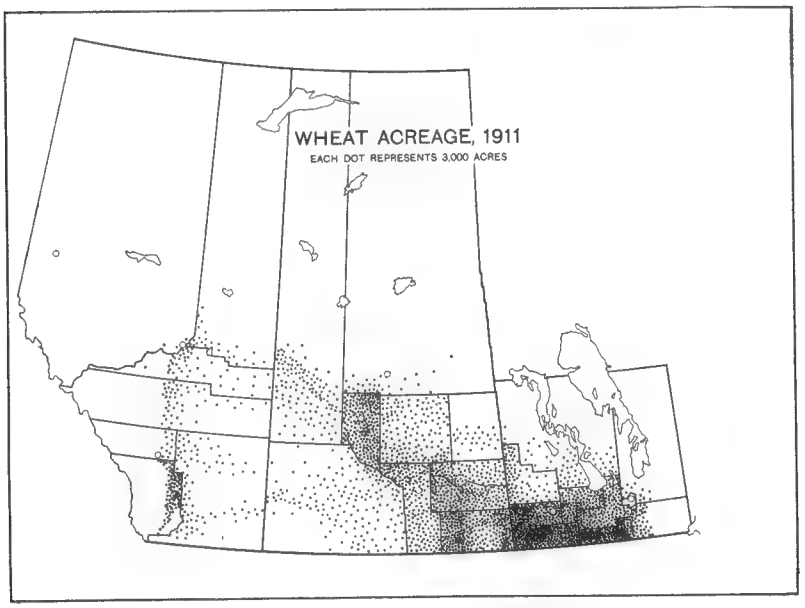
The main objects of the summer fallow are to collect moisture for the next season's crop, and to increase the availability of the plant foods. When land is ploughed and kept free from weeds the water which normally would pass out through the plants is kept in the soil, provided, of course, the soil is of a retentive nature. It is quite evident that early ploughing or cultivation of the fallow is important, because it stops the loss of water caused by the transpiration of growing plants. Weeds, when permitted to grow on the fallow, pump water from the soil in exactly the same manner as any of the crops, and thus defeat the main object of the summer fallow. If a soil sample from a good fallow is compared with a sample from a weedy fallow or a cropped soil, it is found that the good fallow sample contains much more moisture than either of the other samples.

Since a good fallow has a higher moisture content and better conditions for the decomposition of organic matter, it is found to contain more available plant foods than a poor fallow or cropped soil. From published data of the Soils Department of the University, fallow at Edmonton was found to contain from 5 to 10 times as much soluble nitrate nitrogen as cropped soil at the end of the growing season. Data from soils collected from the southern end of the province show fallow to contain at least three times as much nitrates as cropped soil.[11]

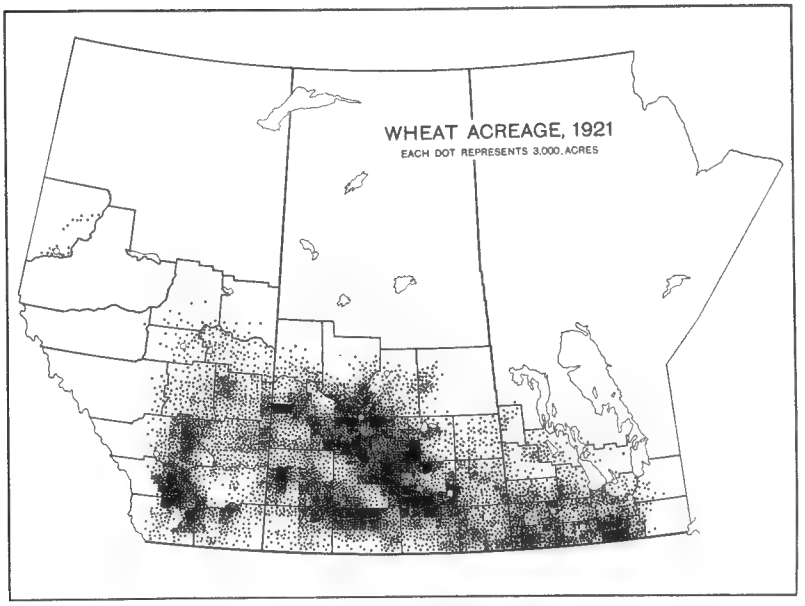
The semi-arid plains were thrown open to homesteading in 1909. Settlement was extremely rapid in 1910 and 1911. Ranching gave way to grain farming. Crops in the first years were good with the exception of that of 1914. In 1915 the record crop was harvested; whole districts yielded 40 bushels of wheat per acre. The next two years were also excellent years. Then followed a long period of drought. From 1918 to 1926 only two years were better than average and the others were far below it (see Table VIII and Fig. 149).

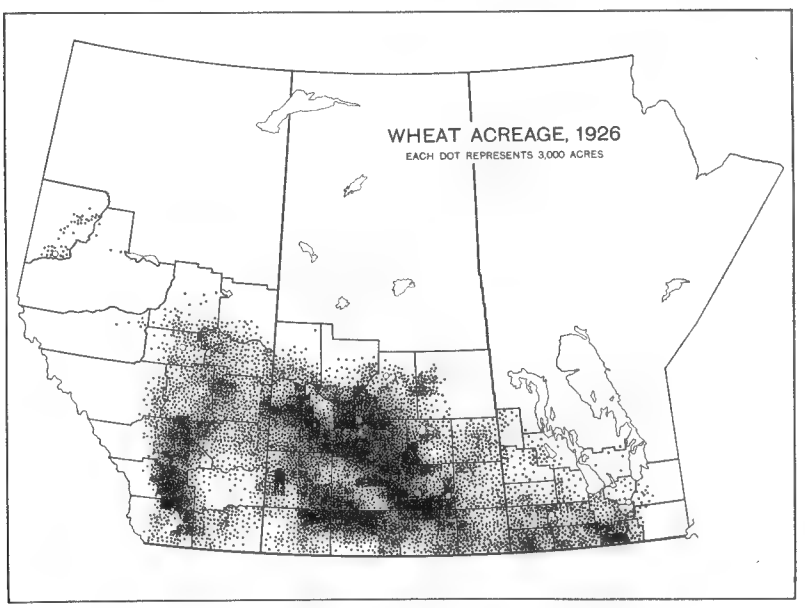
[11] Wyatt and Newton, *op.cit.*, pp. 44-45.





FIGS. 99-100—Wheat acreage in 1901 and 1911 (*Statistical Atlas*). In Figures 99-102 the territorial unit is the municipality.





FIGS. 101-102—Wheat acreage in 1921 and 1926 (*Statistical Atlas*).

TABLE VIII—WHEAT YIELDS IN THE SEMI-ARID ZONE.
(bushels per acre)

	LETHBRIDGE*	MEDICINE HAT*	SOUNDING CREEK†	SOUTHWESTERN** SASKATCHEWAN
1905	9 4	15.9		
1906	21 8	18.7		
1907	21 3	11 4		
1908	20 7	7 7		
1909	19 8	22.8		
1910	6 8	7 0		
1911	20 7	18 2		
1912	16 7	15 6		
1913	18 6	11.1	17 9	
1914	6 3	3 2	8 9	
1915	43 6	37 5	40 4	
1916	34 7	23 3	29 1	18 1
1917		20 0	18 0	12 2
1918	7 1	3 0	5 4	4 7
1919	5 2	2 4	5 5	3 5
1920	13 0	7 7	15 7	9 9
1921	9 8	7 2	7.9	8 6
1922	18.5	9 3	6 7	18 7
1923	32 8	22 5	20 8	16 7
1924	17 0	6 0	6 0	6 8
1925††	18 9	8 9	10 0	9 8
1926	20 0	9 0	9 0	8 8
1927	29 6	30 4	26 4	26 9
1928	27 1	28 6	22 8	27 1
1929	18 5	12 7	5.5	13 2
1930	21.1	9.9		13 1

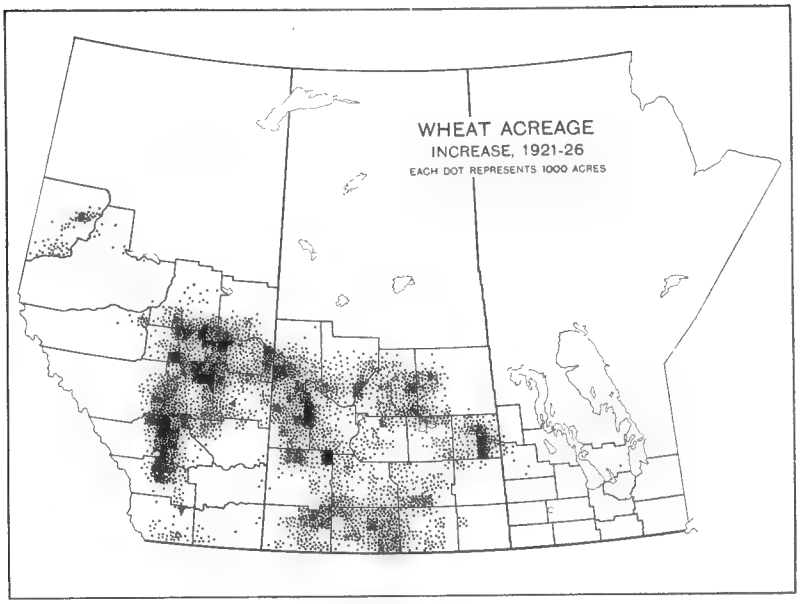
* F. A. Wyatt and J. D. Newton, *Soil Survey of Medicine Hat Sheet* (Edmonton: University of Alberta, College of Agriculture, 1926), p. 14.

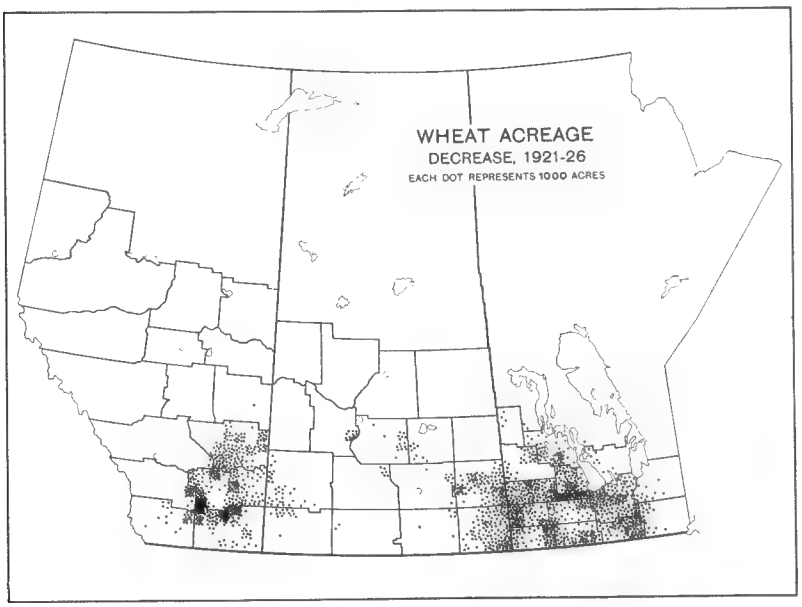
† F. A. Wyatt and J. D. Newton, *Soil Survey of Sounding Creek Sheet* (Edmonton: University of Alberta, College of Agriculture, 1927), p. 13

** *Report of Secretary of Statistics* (Regina: Department of Agriculture, Saskatchewan, 1931), p. 18.

†† From 1925 to 1930 the figures are for the corresponding Census divisions and crop-reporting districts (see Fig. 149).

In the period of high prices the farmers of the dry belt were able to continue with low crop yields, but after the collapse of wheat prices in 1920 the continuing drought took its toll in farm abandonment. Marginal farmers abandoned marginal land. Better crops in 1927 and 1928 induced some reoccupation of abandoned land, but the disastrous crop failure of 1931 occasioned fresh abandonment.





FIGS. 103-104—Increase and decrease in wheat acreage, 1921-1926 (*Statistical Atlas*). The territorial unit is the municipality.

Abandonment of land creates many problems. With a sparse population it becomes difficult for those remaining to maintain the social services to which the community has become accustomed. The burden of maintaining schools, roads, and telephones becomes intolerable: country towns which previously offered many services to the surrounding farmers decline until only a general store remains; doctors and dentists move out; the whole community reverts to the pioneer stage, the stage when the community is deficient in those services which characterize the mature and progressive settlement. There is also the more

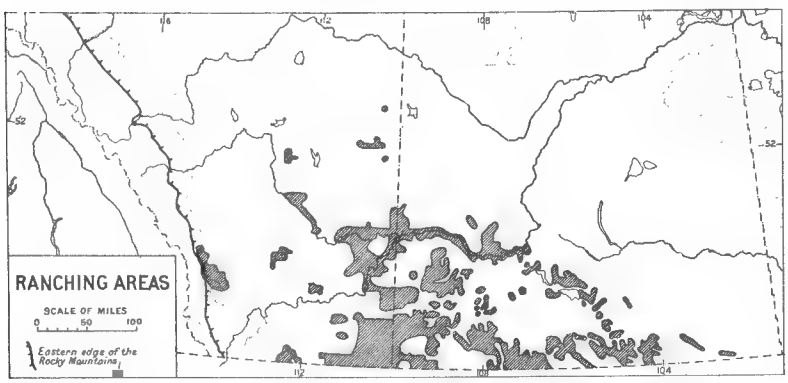


FIG. 105—Ranching areas as indicated by Crown grazing leases (based on the published maps of the National Development Bureau). It should be noted, of course, that in addition much privately owned land is used for ranching.

relevant problem of the possible reclamation of abandoned land. Soon the land deteriorates and is worth less than the unbroken prairie.

On account of a series of dry years much of the land that had been homesteaded and broken for wheat farming was, a few years later, deserted, and this land has become very weedy, Russian thistle being especially abundant. Gradually, however, these weeds are being displaced by native grasses, and eventually a good grass sod will be formed, and the land will once more be valuable as pasture or ranch land. No doubt this process could be hastened in many places by sowing suitable grass seed.

Even yet settlers are moving from the district, and it is evident that the unmodified wheat-farming practice cannot be depended upon as a permanent system of agriculture. Where suitable water supplies are available from wells or rivers, some livestock should be kept, and some forage or green feed crops should be grown in addition to the wheat crop. Among the forage crops which might be suggested are rye, oats, corn, brome grass, and sweet clover. It is possible to produce green feed for livestock in dry years when the wheat crop

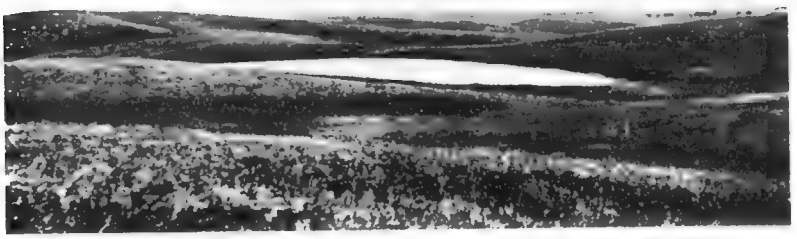


FIG. 106.

FIG. 107.

FIG. 108.

FIG. 106—Ranching land along the Missouri Coteau west of Moose Jaw. The rolling hills, gravelly or stony soil, and frequent sloughs are characteristic. (Saskatchewan Soil Surveys.)

FIG. 107—Short-grass range on "blow-out" soil in southwestern Saskatchewan. Note the uneven short grass and the sage at the left. (Saskatchewan Soil Surveys.)

FIG. 108—Charactertistic range land in southeastern Alberta. Note the evidences of over-grazing. (Dominion Department of Agriculture.)

is not satisfactory. Cattle and sheep should be kept in greater numbers, and some of the land could then be left in pasture at all times.

For much of the rougher land, however, and for some of the larger sand areas, the only solution would seem to be to turn the land back to ranching. Here again, of course, an adequate water supply is essential. Increases in cattle and sheep ranching are to be expected.[12]

The Prairie Plains are "Palliser's Triangle"; the area of greatest farm abandonment is the centre of that "Triangle". Palliser

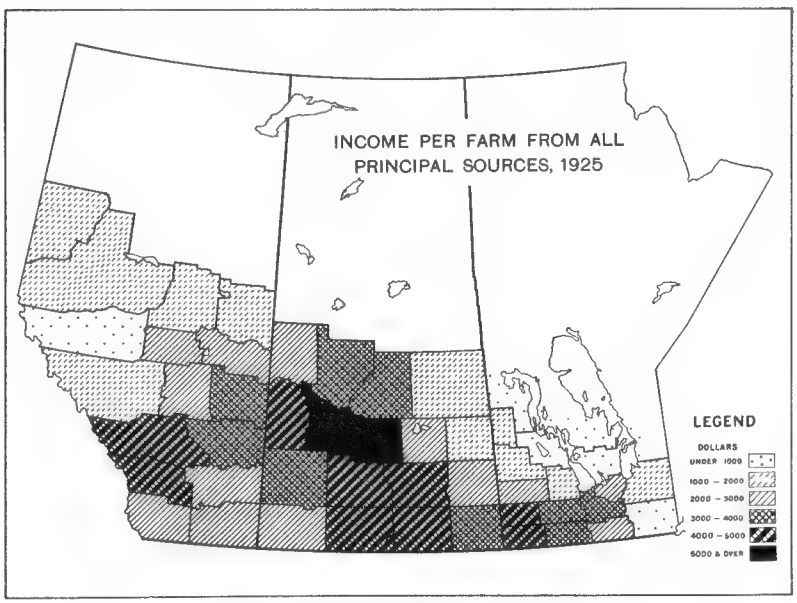
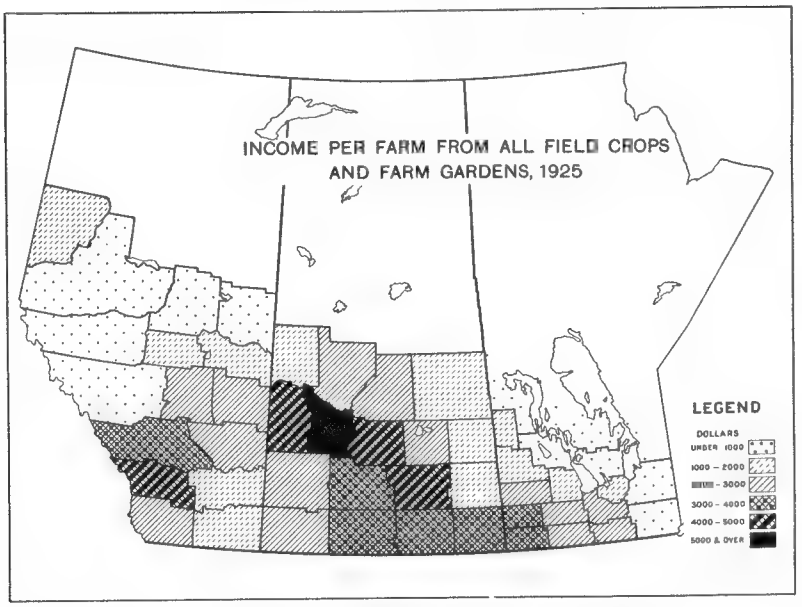


FIG. 109—Income per farm from all principal sources, 1925 (*Statistical Atlas*). The territorial unit is the census division.

and Hind considered it quite unfit for settlement, and many a discouraged settler abandoning his homestead to "trek" north in 1931 to make a second effort in the bush country of the Beaver River or in the valley of the Peace wholeheartedly agreed.[13] The attempt to settle "Palliser's Triangle" was made with equipment of which Palliser and Hind knew nothing. The plough of 1860

[12] Wyatt and Newton, *Soil Survey of the Sounding Creek Sheet*, p. 15.

[13] In June, 1931, driving south in western Saskatchewan from the Beaver River, in the wooded country, to St. Walburg, the writer met in one afternoon twenty-eight settlers' "outfits",—covered or uncovered wagons, three to five horses, a cow, a pair of pigs, a few implements, a little furniture, a man, his wife and children. All told the same story: "We know we will not make money up here, but we can build a home, we can get enough to eat and wear and, at least, it rains." They had never heard of Palliser, but they shared his opinions.



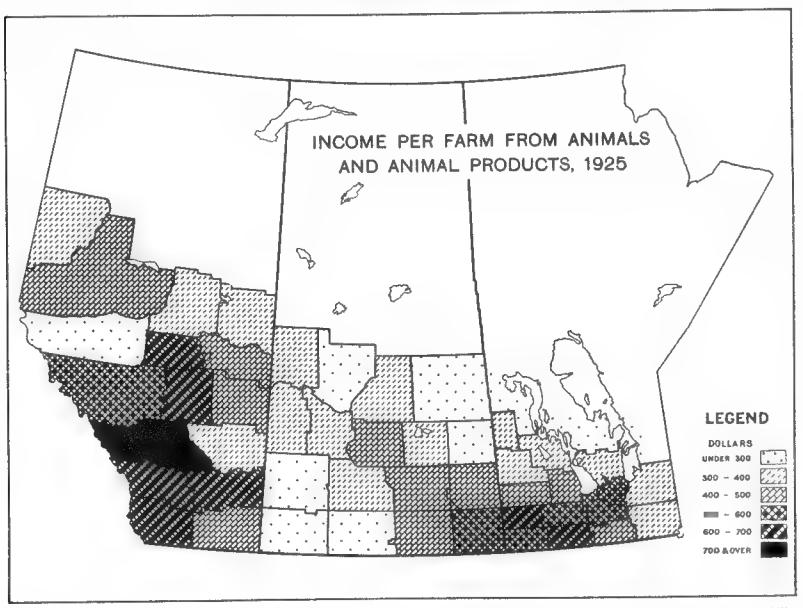


FIG. 110—Income per farm from all field crops and farm gardens, 1925 (*Statistical Atlas*). The territorial unit is the census division.

FIG. 111—Income per farm from animals and animal products (*Statistical Atlas*). The territorial unit is the census division.

would not have broken the tough prairie sod; the wheat of Palliser's day required a month longer to mature than Marquis; dry-farming practices were unknown. Settlement had a far better chance of success than Palliser could know.

There are two popular solutions for the problem of the "dry belt". Either grain farming must be abandoned in favour of "mixed farming" or agriculture must give place to grazing. The

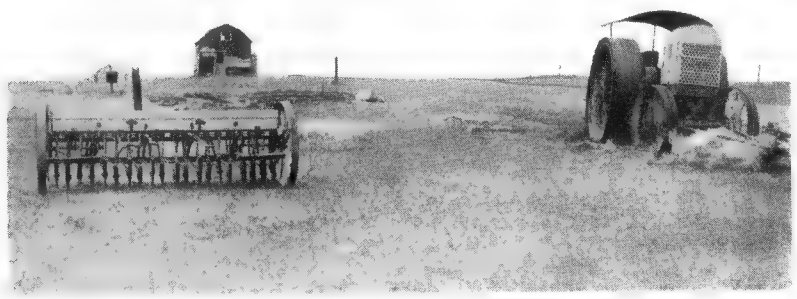


FIG. 112—Abandoned farm and machinery in the "Alberta dry belt".

relative claims of different systems of land utilization will be discussed in Volume V of this series. It is sufficient to say here that either of these as a comprehensive policy is absurd and impracticable. If by "mixed farming" is meant a combination of dairying, livestock, hay and forage crops, limitations of water supply and limitations of markets are insurmountable. When markets expand sufficiently to encourage dairying on the Canadian Plains the comparative advantage will lie with the Park Belt. Not until mixed farming, which the Canadian banker has eulogized so insistently, has dominated the sub-humid and humid sections of the country will it make significant progress in the semi-arid districts. It is quite true, as the soil experts have pointed out, that farm practice should be modified.[14] The common rotation fallow, wheat, wheat or oats and fallow is uneconomical. The introduction of forage crops and inter-tilled crops wherever it is possible to use the products is undoubtedly improved practice. Wherever water is available the raising of more livestock lessens

[14] *Soil Survey of Local Improvement Districts Nos. 21, 22 and 52, and Reno Municipality No. 51* (Saskatoon: University of Saskatchewan, College of Agriculture, Soil Survey Report No. 3, 1925), pp. 18-25

the risk of farming, and provides a use for corn, clover, and hay. It is important to note, however, that the most important reason for urging changes in the common farm practice of this area is that improved rotations will conserve the moisture and the moisture-retaining powers of the soil and *permit the more efficient and dependable production of wheat.* In other words, the object is to make possible more efficient specialization in grain farming.

There are in this section many acres in which inferior soil or topography render wheat growing a less effective use of land than grazing, if an adequate water supply is available. Ranching may be expected to increase and the re-settlement of certain areas should be prevented, but there is no possibility that over any large proportion of the semi-arid plains of Canada ranching will supplant grain farming.

Permanent settlement of the dry belt will probably be advanced in three ways. First, as markets expand some increase in the irrigated areas may be expected. Secondly, areas less favoured in topography and soil but better watered will turn more strongly to grazing. Thirdly, grain growing with improved rotations and improved tillage, larger enterprises with sufficient capital to average the good years with the bad, will use the better soils and the better topography. Unless development is carefully watched and controlled, there may be much wastage of capital and human effort, while the proper adaptation to the facts of geography is being achieved.

CHAPTER VII

THE FOREST AREAS

NORTH, northeast, and west of the Park Belt extends the wooded country. Lower evaporation and cooler temperatures promote a forest rather than a grass cover. The trees range from light scrub to substantial poplar, spruce, and jack pine, quite large enough for use in log buildings. Most of the wooded area in Manitoba lies within the Precambrian Shield; in Saskatchewan it is divided more or less equally between the Precambrian Shield and the continental plain; while in Alberta only the northeastern corner is included in this Laurentian area (Fig. 23).

Settlement early entered the wooded areas of the West. By 1901 population had attacked the forest northeast of Winnipeg, in the Prince Albert district, and west of Edmonton (Fig. 43). Settlement began early but advanced slowly. In 1931 settlement had encroached on the forest all across the northern fringe and had invaded the wooded area in some sections to considerable depths (Fig. 49). The history of settlement in these areas, however, shows nothing comparable to the swift peopling of the open prairies. Extension has been difficult and slow.

In part, once the early prejudice against the grassland had been dispelled, the greater attractiveness and ease of settlement in Park and Prairie Belts prevented any rapid progress in the wooded areas. In part, the slowness with which railways came to serve the sparse settlements of the Forest Belt was an obstacle to further settlement. In part, also, the facts of physical environment prescribed limits to settlement, which, if not rigid, were at least difficult to push back.

The cost of clearing the land was a powerful deterrent. The expense was a direct monetary outlay only when the settler hired others to do his clearing. It was the slowness with which the land could be made ready for a crop which was the cost to the pioneer. He could hope to clear only a few acres yearly, and for a long time he could not adopt the machine technique which the settler in the grasslands was using. On the prairie the homesteader of the previous summer might have 30 or 40 acres of land

in crop. In addition, he might have some flax on spring "breaking" (i.e., land ploughed for the first time). In addition to feed for his stock it was possible for him to have wheat and flax to sell for much needed cash. If luck was with him, and he believed it would be, he might harvest thirty or more bushels of wheat to the acre, and have as much as 600 bushels for sale. The settler beyond the forest line was likely to have little for sale except a few animals, which would pay for only the most essential of his requirements. Only if he was able to expend capital on the clearing of his land, could he hope to have quickly any considerable produce for sale.

Of the wooded margins of the Melfort district, adjoining to the southeast the confluence of the North and South Saskatchewan Rivers, it was said in 1928:

> In general, extensive clearing operations with the use of power are cheaper and far more rapid than small scale operations with only man and horse labour. At present most land is cleared by hiring Indians and Indian breeds to cut, and by using the tractor and heavy bush breaker plough to break. With the use of power, one can probably prepare these bush and brush lands at least three times as quickly as by hand methods. As a consequence, large areas may be put in crop in a reasonably short time. This will enable the farmer to produce on a sufficiently large scale to fairly quickly pay clearing costs, and to successfully operate his farm.[1]

In view of the great amount of time required for clearing land without power equipment a Saskatchewan Royal Commission recommended in 1930 that

> plans be considered for the creation of land-clearing corporations (either by government or private enterprise) which might undertake such work, and recoup themselves for their expenditure by adding the cost of clearing and breaking land to the price at which land is sold to the settler.[2]

In the period of rapid settlement, the commercial possibilities of prairie settlement much outweighed the meagre attractions of wooded country. True, the pioneer in the forest had fuel and building material which the prairie settler lacked, but these did not weigh heavily in the balance against the lure of quick gain from cash crops on the prairie.

The labour of clearing in the western forest was, of course, much less than that undergone by the pioneers of eastern Canada. The poplars and small conifers have neither size of trunk nor depth

[1] *Soil Survey of the Birch Hills-Melfort Area* (Saskatoon. University of Saskatchewan, College of Agriculture, 1928), pp 44-5

[2] *Report of the Saskatchewan Royal Commission on Immigration and Settlement 1930* (Regina. King's Printer, 1930), p. 152.

of root comparable to the trees of the eastern forests. Moreover, the difficulty of clearing operations varies widely from point to point in the western forest. Much, perhaps most, of the area of woodland settlements lies in a transition soil belt in which the forest has invaded the grasslands. Palliser thought the Park Belt and the lightly wooded area beyond to be an encroachment of the grassland on the forest with the aid of frequent fires set by the Indians.[3] Soil scientists, however, find here typical grassland soils, somewhat deteriorated in proportion to the time which has elapsed since the forest cover displaced the grasses.[4] In this transition belt the amount of clearing to be done varies from place to place. Small areas of open parkland are surrounded by a light forest cover easily cleared. On poorer, higher, or northward sloping land the stand of trees is heavier and clearing proportionately more costly. "Light clearing" in the wooded areas of the Peace River Country involves a cover of three- to six-inch aspens, willow, and poplar scrub and in 1929 cost $8.00 to $12.00 an acre. "Medium to heavy clearing" of pine, aspen, alder, and willow cost $15.00 to $20.00 per acre. "Heavy bush consisting of belts of aspen and willow alternating with solid belts of 9-inch pine" cost $20.00 to $40.00 per acre to clear[5] (Fig. 113).

Settlement in the Forest Belt (Fig. 114) has frequently been simply a gradual extension from adjacent grassland areas. Where settlers have gone into the forest area a considerable distance from existing settlements, they have usually been attracted by the small open "prairies" or parkland which are of frequent occurrence in the transition belt. In these open spaces, where little clearing was necessary, nuclear settlements have been established to which additional settlers continued to come long after the more desirable land had been occupied. The newcomers took up the poorer land and the heavier clearing. "Prairies" of this sort are particularly frequent and large in the valley of the Peace, but they occur also in northern Manitoba and northern Saskatchewan. Meadow Lake, High Prairie, Grande Prairie, Clear Prairie, Rose Prairie are the suggestive names of such nuclear settlements from which population has extended into the wooded areas.

Cost of clearing is one obstacle to settlement in the wooded

[3] See above, p 33

[4] F. A Wyatt and O R Younge, *Preliminary Soil Survey Adjacent to the Peace River, Alberta, West of Dunvegan* (Edmonton Research Council of Alberta, Soil Survey Division, Report 23, King's Printer, 1930), p 23.

[5] *Ibid.*, p. 15.

areas of the Prairie Provinces; a high proportion of inferior soil is another. Soils in these districts (Fig. 24) range from the best parkland soils in the "islands" of open "prairie" to inferior bush soils in the true Forest Belt (Figs. 116, 117, 118). The parkland soils are not typical of the Forest Belt and, though of importance for settlement, do not represent any considerable percentage of the whole wooded area.

FIG. 113—Heavy clearing in Alberta wooded soils area (Alberta Soil Surveys).

The typical wooded soils are described as follows:

Typical wooded soils in Alberta have the following characteristic profile. The upper layer or horizon A_0 consists largely of leaf-mould or plant debris, and varies in thickness from one to four inches. Immediately under this there is a very thin layer, A_1, of drab to brown-coloured mineral soil which varies in thickness from half to about two inches. The A_1 layer is not always present in the wooded soils. This A_1 layer is underlain by a light-coloured, badly leached A_2 layer varying in thickness from four to twelve inches. Below the leached, light-coloured layer is found a darker-coloured B_1 layer, which is much heavier in texture than the above layers, and contains large quantities of the finer clay particles which have passed downwards during the processes of leaching. This layer varies in thickness from one to four feet. The B_2 or lime layer is not encountered in the more mature areas of these wooded soils nearer the surface

FIG. 114—A settler's homestead in the forest area near Prince Albert, Saskatchewan (Canadian National Railways).

than from four to six feet, whereas in the northern parts of the wooded soil belt the B_2 horizon is at times found within fourteen to twenty inches below surface.

. . . . . .

From the above description of a wooded soil profile it will be understood that the wooded soils have suffered considerable leaching. The extent to which a soil has been leached depends upon several factors other than natural rainfall. Soils that have developed for a long period of time under forest conditions have usually been leached to a much greater extent than soils which have developed under grass or prairie conditions. Forest soils tend to remain damper than prairie soils throughout the summer, and this results in greater leaching of forest soils. Grass roots form a thick network close to the surface and this also tends to prevent leaching. Furthermore, it is doubtful if the original

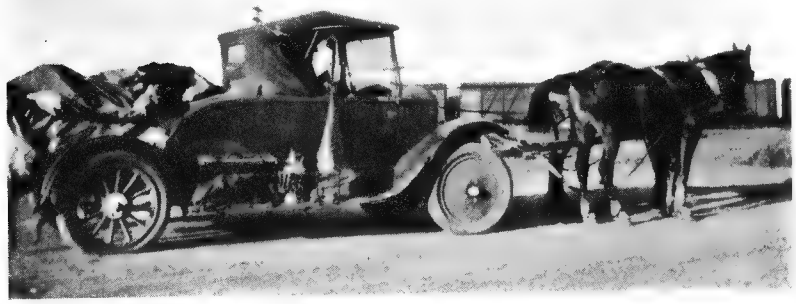


FIG. 115—Landseeker, 1932 style.

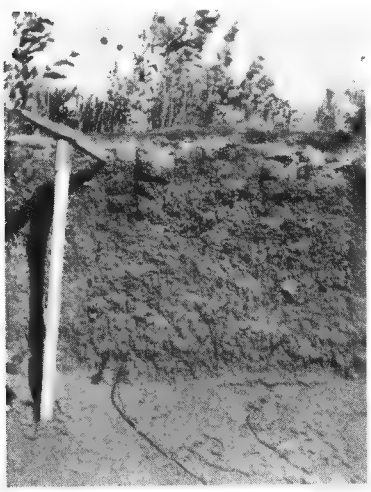
wooded soil material in Alberta contained as much (free) lime as the black park belt soils. After the (free) lime is removed by weathering processes, leaching or soil degradation occurs rather readily.[6]

Though the surface-soil of the wooded areas is very similar in composition to the surface-soil of the Park Belt, it is usually of very shallow depth. Such soils are deficient in the essential plant foods and, while at times producing satisfactory crop yields, will only continue to do so if carefully managed and built up. Table IX shows a comparison of a typical wooded soil and a black park soil (p. 144).

The Province of Alberta, in common with the other two Prairie Provinces, was given in 1930 control of its land and other natural resources which had been vested in the Dominion Government

[6] F. A. Wyatt and J. D. Newton, *Wooded Soils and Their Management* (Edmonton: University of Alberta, College of Agriculture, Bulletin No. 21, 1932), pp. 9-10.

since the acquisition of Rupert's Land in 1870.[7] Having larger areas of wooded soils under active settlement, the Alberta Government has been particularly alert in investigating the agricultural possibilities of the wooded soils and in preventing settlement where unsatisfactory results were likely to follow. Reconnaissance soil surveys have, during the past four years, covered typical areas throughout the northern half of the province. Soils



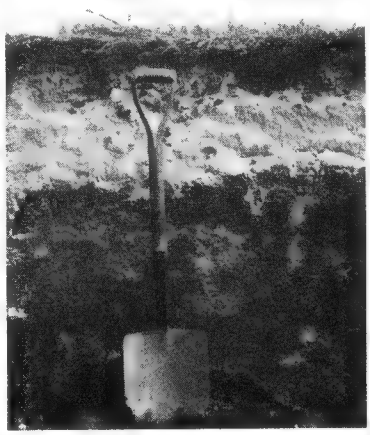


Fig. 116—(left) Profile of transition wooded soil. Note the leached layer and granular subsoil. (Alberta Soil Surveys.)

Fig. 117—Profile of better-grade wooded soil. Note black surface soil and badly leached layer. (Alberta Soil Surveys.)

have been classified as first- and second-class prairie soils, first-, second- and third-class wooded soils, and rough lands and muskegs. Classification in the first four groups has been based chiefly on the depth of the surface layer of black soil, the extent of leaching, the cost of clearing, and the character of the topography. It has been recommended generally by the soil experts that third-class wooded soils and rough lands be closed to settlement and converted into forest and game reserves, but that the necessary roads be built to facilitate settlement of the prairie soils and the first- and second-class wooded soils.[8]

[7] See Volume II in this series.

[8] Wyatt and Younge, work cited in footnote 4, pp. 31-33.

Muskegs and peat bogs are numerous in the wooded areas (Fig. 119). As a rule the peat is not thick, and some areas covered with peat are being reclaimed by drainage, with varying degrees of success. In the Carrot River valley, which west of the Pasquia Forest Reserve parallels the lower Saskatchewan River above The Pas, substantial areas have been drained by the ditches incidental to highway construction. After the land is drained,

FIG. 118—Profile of poor-grade wooded soil. The badly leached layer begins almost at the surface and extends downward three feet. (Alberta Soil Surveys.)

the peat is partly burned off and the land easily broken. Considerable settlement took place on these lands in 1929 and 1930 with apparently satisfactory results. In the main, however, such lands offer little hope for successful settlement. Extensive areas of muck and peat lands occur frequently in the Forest Belt. They are particularly extensive in eastern Manitoba, in the districts surrounding Lakes Manitoba and Winnipegosis, and in that part of Alberta lying east of the Peace River.

Partly because of the more northerly latitudes, partly because of lack of air drainage, frost (Fig. 148) is a factor which modifies

settlement and land utilization in the wooded areas of the West. Frost, however, does not establish any absolute limits to agriculture, unless it be the boundary of permanently frozen surface soil. Frost is a greater or a less hazard which is added to the other hazards determining success or failure. The loss of one crop in five and the deterioration of a second greatly reduces the revenue to be derived from a given area of land, and standards of living will be correspondingly reduced. It is likely to prohibit settlement, however, only as more attractive opportunities are available elsewhere. The problem is not one of absolute physical limitation but of economic choices in which the important underlying conditions are physical.

TABLE IX—TOTAL PLANT FOODS IN UPPER FOOT OF TYPICAL WOODED AND TYPICAL BLACK SOILS OF ALBERTA* (see text p. 141)

(pounds per acre).

	NITROGEN	PHOSPHORUS	CALCIUM	MAGNESIUM
Wooded soil..	4,530	1,685	19,600	10,800
Black soil . .	19,040	3,835	36,400	17,650

* Wyatt and Newton, in work cited in footnote 6, p 14

As has been pointed out earlier, spring frosts are not a serious hazard in a region producing only spring-sown crops. Not only may seeding be completed before spring frosts have ceased but the freezing of the young grain plants, unless very severe, is not likely to cause deterioration of the crop. Autumn frosts may be evaded by growing only early-maturing crops, and in Canada attention for many years has been focused on the breeding of early-maturing grains. Garnet and Reward wheats, which mature in 100 to 120 days, and which are recommended for use in the Park Belt and north of it (Fig. 64), have been important means of reducing frost hazard. The most dangerous frosts are the summer frosts occurring before grain has begun to ripen, while it is still in the milk stage. Later frosts may cause only slight deterioration of the grain, but the summer frost, if severe, will produce almost total loss.

The hazard of frost, as any other hazard, must from the individual's point of view be conceived in terms of probabilities, not in terms of averages. It is not the average occurrence of frost

but the frequency of its occurrence (Fig. 148) which determines the decisions of the individual with regard to land settlement and utilization. Faced with a known hazard of frost, the farmer will reject certain crops and grow others which over a period of years will yield him a higher income. The length of the growing season will lead him to select certain less hazardous uses of his land, but the length of the *non-growing* season will also have a

FIG. 119—Characteristic muskeg area (Alberta Soil Surveys).

decisive influence on the farm economy. A long period when no pasture is available increases the cost of wintering livestock, and, if little livestock is kept, there is idle labour through the winter unless some auxiliary work is carried on.

Settlement in the Forest Belt has been definitely retarded by the lack of transportation facilities. Trails were the pioneer roads on the prairie, but highways, even though rude, have had to be built in the wooded country. The provision of colonization roads has been a serious financial problem in Saskatchewan and Alberta. Without them the northern settlements would have been isolated, and yet the demands of the settlers have been only partially met.

Railways, too, have been built through the Forest Belt, and yet many settled areas lie outside the twenty-mile belt (Fig. 40). The essential problem is the same. The settlements in the wooded areas are sparse and not continuous. A few miles of productive territory are succeeded by several miles of unproductive territory, and the traffic is not heavy enough to pay the cost of construction and operation. Settlement is hampered by lack of railways, and railways are hampered by sparseness of settlement. Were the productive areas of the Forest Belt gathered into a continuous settlement, the provision of adequate transportation facilities would be a simple problem. As it is, people are too few, traffic is too light, and the miles are too many to permit railway service equal to that provided on the prairie. Truck highways in part are a substitute for railways, though only a poor substitute in the transportation of grain, but highways are little less expensive than railways. Governments are sometimes, however, easier to persuade than railway companies.

Comparison of the map showing density of rural population in 1931 (Fig. 49) with the vegetation map (Fig. 23) shows that considerable areas of the Forest Belt have been settled. The greatest depths of penetration have occurred in the territory between the Manitoba lakes, in northwestern Saskatchewan north of Battleford, and in the areas west, north, and northeast of Edmonton. Density of population in the Forest Belt is, however, much greater in the Manitoba and Alberta areas than in Saskatchewan. Population of densities greater than two per square mile are associated with four factors: (1) The presence of railways is both an effect and a cause of denser population. (2) Close comparison of density of population (Fig. 49) with soil factors (Fig. 24) shows that most of the larger settlements beyond the boundary of the wooded territory are located not on true wooded (podzol) soils but on transition (incipient podzol) soils which retain much of their park soil characteristics. This is true particularly of the settlements northeast and northwest of Prince Albert and those to the west of Edmonton. It is not true of the relatively dense settlements between the Manitoba lakes and to the west of Lake Manitoba. These settlements, which are located on wooded soils, have experienced in the past decade serious a andonment [9] (Fig. 70). (3) In some cases the inhabitants of

[9] R. W. Murchie and H. C. Grant, *Unused Lands in Manitoba* (Winnipeg Department of Agriculture and Immigration, 1926), p 116.

relatively dense settlements in the Forest Belt have found it possible to supplement the farm income by the sale of wood, by fishing, or by work outside the district in the winter.[10] (4) Finally, examination of Figure 58 (in relation to Fig. 49) shows that few of the more densely settled areas in the wooded belt are peopled with Anglo-Saxon settlers.

The record of settlement in the past suggests that satisfactory and relatively permanent settlements are likely to be established on the transition soils of the Forest Belt where substantial areas are available and transportation is feasible. Where the areas available are small and isolated, settlers are bound to lack the social and economic services which are offered by larger communities, or submit to very heavy taxation in order to acquire them. Alternatively, they may obtain them through subsidy by the provincial government. The immediate reason for farm abandonment is frequently heavy taxation; the ultimate reason is the smallness of the farm incomes out of which taxation must come. As soon as abandonment begins the tax burden on the remaining settlers increases.

Wheat, which has been the mainstay of the farmer on the prairie, falls rapidly in importance as one enters the wooded country. While over much of the semi-arid plains more than 80 per cent. of the field crop acreage is in wheat, and in the Park Belt of Saskatchewan and Alberta 60 to 80 per cent., beyond the boundary of the wooded country the ratio falls rapidly to less than 50 per cent., and in the outlying settlements to less than 20 per cent. (Fig. 54). To the degree that wheat declines in importance, oats increases. Over the Plains and Park Belt generally, oats accounts for less than 30 per cent. of the field crop acreage, but in the wooded districts at least 40 per cent. is devoted to oats, and in many sections oats occupy more than 70 per cent. of the crop acreage (Fig. 55). It is perhaps unnecessary to add that, though oats is relatively more important in the Forest Belt than in the other sub-regions, absolutely it is less important.

Oats is favoured by a cool moist climate, but the importance of oats in the wooded belt is due in large part to the factors which discourage the production of wheat. Low yields from inferior soils, soils which will not stand up under persistent cropping, the danger of summer frosts, small fields which hinder machine farming, and, usually, greater distances from markets—these and

[10] *Ibid*, p. 116

other factors militate against the desire of the settler to produce wheat as a cash crop. Further, the wheat produced in the Forest Belt is usually of a lower grade and of lower protein content (Fig. 120). Lacking wheat as the desirable cash crop, the settler in the Forest Belt must, perforce, depend on a variety of products to yield him a living and supply some cash. Oats, whether as threshed grain, in the sheaf, or cut as green fodder, furnishes food for livestock, and in part may even be sold as a cash crop.

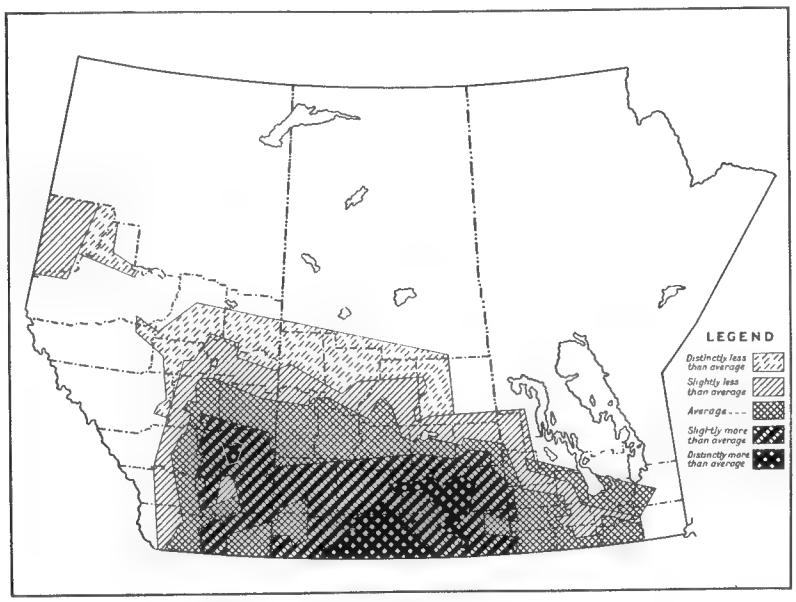


Fig. 120—Map showing protein content of wheat grown in 1932 in areas indicated (based on map by Board of Grain Commissioners, Department of Trade and Commerce, Ottawa).

Livestock has a more important place in the farm economy of the Forest Belt than in those of other regions (Fig. 74). In the more southerly wooded areas, such as that west of a line drawn from Calgary to Edmonton, and in the areas not far from cities, as in the mid-lake area of Manitoba, cattle are important (Fig. 76). The nearness to cities permits the sale of butterfat, and the growing season is sufficiently long to permit the natural grasses to cure on the stem and so provide at least some winter feeding. In the north, swine have a comparative advantage (Fig. 77).

As would be expected, farms in the Forest Belt are much smaller

than on the Plains (Fig. 72). The quarter section is the common size, though the average is larger. Since farms are small, land cheap, and settlement for the most part recent, the proportion of tenancy is low. Whereas in the Park Belt and on the Prairie Plains from 15 per cent. to more than 30 per cent. of the farms are occupied by tenants, in the Forest Belt generally tenants occupy less than 10 per cent. of the farms.[11]

On the basis of soil and land-classification surveys, Newton concludes that only the transition soils of the wooded area are suitable for cultivation, although some of the true timber soils will be used in conjunction with better types[12] and are capable of substantial improvement under careful management.[13] Newton estimates that, aside from the Peace River Valley, the transitional soils, i.e., those covered with forest vegetation but of characteristics intermediate between the typical parkland soils and the typical wooded soils, cover an area in the three provinces of about 43,000,000 acres, of which 5,731,000 acres are suitable for cultivation and 7,650,000 acres marginal for cultivation. In addition to these there are in the mid-lake district of Manitoba, where the soils are of the wooded variety but with a high lime content, 1,000,000 acres suitable for cultivation and 2,000,000 acres of marginal land.[14] Thus the "suitable" area in the wooded belt is slightly more than one-third of the "suitable" land in the Park Belt, and less than 40 per cent. of the suitable land in the Prairie Plains. Very large areas of land lying wholly in the grey timber soil zone in all three provinces are considered to be unsuited for agricultural settlement. Undoubtedly, small areas of suitable land are to be found here, but rarely large enough to support a satisfactory settlement. Of the total area (excluding the Peace River district) considered in this estimate, 16 per cent. is thought suitable for cultivation, 22 per cent. marginal for cultivation, and 62 per cent. not suitable for cultivation.[15] It should be noted, however, that the land classed as "marginal for cultivation" has been recommended for settlement in Alberta.[16] As in the other

[11] *Agriculture, Climate, and Population of the Prairie Provinces of Canada, A Statistical Atlas Showing Past Developments and Present Conditions*, prepared under the direction of W. Burton Hurd and T. W. Grindley (Ottawa: Dominion Bureau of Statistics, 1931), p. 65.

[12] See Appendix, pp. 207, 209.

[13] Wyatt and Newton work cited in footnote 6, *passim*.

[14] See Appendix, pp 229-232

[15] See Appendix, *Ibid*

[16] Wyatt and Younge, work cited in footnote 4, p. 138.

soil belts, considerable areas of the inferior land will be used for pasture in conjunction with the better land.

Over the whole transitional soil belt from Manitoba to Alberta from 33 to 70 per cent. of the land is classed as unsuitable for cultivation. On the basis of this evidence one can predict that the density of settlement in these areas will remain low, and that the problem of maintaining adequate transportation, governmental, and social services for the settlements will be correspondingly difficult. The proportion of marginal land in this soil belt ranges from 20 to 30 per cent. The problem of misdirected or mistaken settlement is, therefore, likely to be as important here as in the semi-arid belt (see Fig. 70).

CHAPTER VIII

THE PEACE RIVER COUNTRY

EAST of the Rocky Mountains, between latitudes 54° N. and 59° N. and extending eastward to longitude 113° W. is the Peace River Valley (Fig. 121). The greater part lies in the province of Alberta, but the Peace River Block of British Columbia embraces an area of 3,500,000 acres.[1] The Peace River

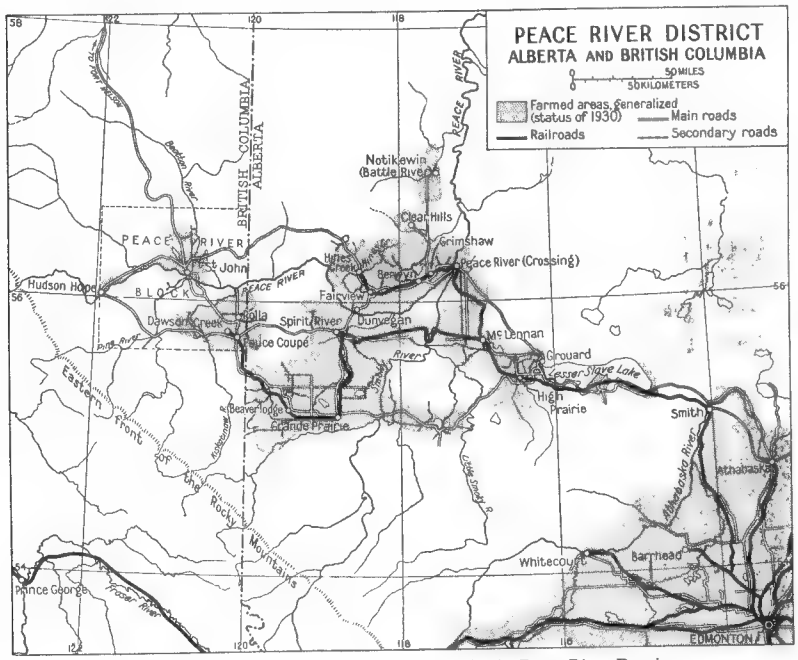


FIG. 121—Sketch map showing settled areas in the Peace River District.

country lies to the northwest of Edmonton, which is approximately 318 miles north of the United States boundary. Joined to Edmonton by rail and motor highway, it is separated from it by an extensive area of rough wooded country, part of which is included in the Lesser Slave Lake Forest Reserve. Grande Prairie, the

[1] The Peace River Block is an area of which the natural resources were transferred by the province of British Columbia to the Dominion in consideration of the construction of the Canadian Pacific Railway It remained under the jurisdiction of the Dominion until 1930, when it was returned to the province.

centre of the southern settlements of the Peace River district, is 426 miles north of the United States boundary, while Fort Vermilion, at the northern extremity of the Peace River settlements, is 648 miles from the boundary.

This sub-region is included in the Forest Belt (Fig. 23), although much of the land is parkland or very lightly forested. Indeed, it may be considered the last outpost of the grasslands of the interior of this continent. The area possesses, however, such distinct characteristics as to entitle it to separate treatment.[2]

FIG. 122—The junction of the Peace and Smoky Rivers (looking west).

The Peace River Valley is the area in which settlement has been most active during the past decade. Here in recent years has been recapitulated much of the history of the Canadian West. The land-seeker, the squatter, the homesteader, and the settler with capital buying land—familiar figures of the agricultural frontier of North America—are still active in the Peace River country. Villages have sprung up in a few weeks, "the end of steel" is busy with the activities of settlement, and men talk unceasingly of "the future of the country". The modes of settlement have been modified, however, by the automobile, the tractor, the radio, and indeed, by the aeroplane. Even on the frontier, man attacks nature with the aid of mechanical power. Though not necessarily the last agricultural frontier in Canada, the Peace River country is the largest single area of active settlement.

A special interest in the settlement problems of the Peace River

[2] See Volume VI in this series.

is aroused by its northerly latitude. In eastern Canada agriculture, even pioneer agriculture, has not extended much beyond 49° north latitude. The southern boundary of the Peace River Valley is about 54°, and land has been homesteaded and is being tilled north of 58°. Only in Siberia, where settlement is also pushing northward, does one find similar problems of northern settlement in a continental interior.[3]

Not only are the settlements of the Peace River more northerly than other Canadian agricultural settlements, but they are far

FIG. 123—Looking northeast at the junction of the Peace and the Smoky. The uplands are about 800 feet above the water, and the valley, between the plateau escarpments, is over a mile wide.

removed from outside markets. Grande Prairie is 407 miles by rail from Edmonton, 1,178 miles from Vancouver, and 2,555 miles from Montreal, its two ocean ports. Export rates on grain from the Peace River are only slightly higher than those from Edmonton. On other products and on inward freight, however, the greater distance is reflected in higher rates.

The drainage basin of the Peace presents varied topographical features (Fig. 2). Essentially a part of the Great Central Plain, the valley slopes northeastward from an altitude of approximately 2,400 feet at the western boundary of the Peace River Block to 699 feet at the water level of Lake Athabaska. The whole area is a plateau, distinctly lower in altitude than the southern section of the third prairie level. The surface is broken by numerous

[3] See L. I. Prasolov, "The Climate and Soils of Northern Eurasia as Conditions of Colonization", *Pioneer Settlement* (New York: American Geographical Society, Special Publication No. 14, 1932), pp. 240-260.

FIG. 124—The north bank of the Peace at Dunvegan. Note the lack of trees and even of grass on the north bank.

FIG. 125—The south bank of the Peace at Dunvegan. Note the wooded slopes.

FIG. 126—Rough eroded lands along the Clear River, a tributary of the Peace (Alberta Soil Surveys).
FIG. 127—One of the frequent coulées of the Peace River country.

uplands rising 500 feet or more above the surrounding country. The channels of the Peace and of its tributaries are deeply cut, the plateau level being frequently as much as 800 feet above the river level (Fig. 123). Characteristically, the north banks of the rivers are bare of trees and sometimes even of grass, while the south banks are wooded (Figs. 124, 125). Draws and creek-bottoms greatly extend the eroded areas which are not suitable for cultivation (Fig. 126).

Fifty years ago Macoun deduced from the vegetation of the Peace River Valley that its summer temperatures were not lower than those of the prairies to the south. Noting that the same flora extended as far north as 60°, he concluded that "as that flora required a high summer temperature for its existence, the thermometer would be found to show a corresponding distribution of heat throughout the whole district."[4] Subsequently acquired meteorological information bears out Macoun's prediction. Virtually the whole of the Peace River area, except the southwestern corner and the higher altitudes, has a mean summer temperature of 57° or higher (Fig. 14). Most of the province of Alberta north of Calgary is in this summer temperature belt. A small area north of Edmonton has a mean summer temperature of 59°, while in the higher altitudes approaching the Rocky Mountains lower average temperatures prevail. The highest temperatures recorded in the Peace River Valley are of the same order as those recorded in the southern parts of the province. The beginning of spring, defined as the attainment of a daily mean maximum temperature of 43°, is rather earlier in the upper Peace River Valley (April 1 to 6) than in the valley of the Red River in Manitoba. Earlier springs occur in the Prairie Provinces only in southern Alberta. Winter sets in along the upper Peace five to ten days earlier than in southern Manitoba and about two weeks earlier than in southern Alberta.[5] As a result, the average interval between the beginning of spring and the beginning of winter is less than ten days shorter in the upper Peace River Valley than at Winnipeg, but nearly a month less than in southern Alberta. Spring progresses across the Canadian plains from southwestern Alberta to the southwestern shore of Hudson Bay; it reaches the Peace River, the newest

[4] John Macoun, *Manitoba and the Great North-West* (Guelph, Ontario, 1882), p. 143.

[5] *Agriculture, Climate and Population of the Prairie Provinces of Canada, A Statistical Atlas Showing Past Development and Present Conditions*, Prepared under the direction of W. Burton Hurd and T. W Grindley (Ottawa: Dominion Bureau of Statistics, 1931), p. 9.

settlement of the West, a little earlier than it reaches the Red River the earliest settlement.

The Peace River shares with other northern settlements a longer summer day than is enjoyed further south (Fig. 128). The time between sunrise and sunset on June 21st is about 17½ hours, while at Winnipeg it is less than 16½ hours, and at Toronto it is about 15½ hours. Further north, at Fort Vermilion, the interval is more than 18 hours.

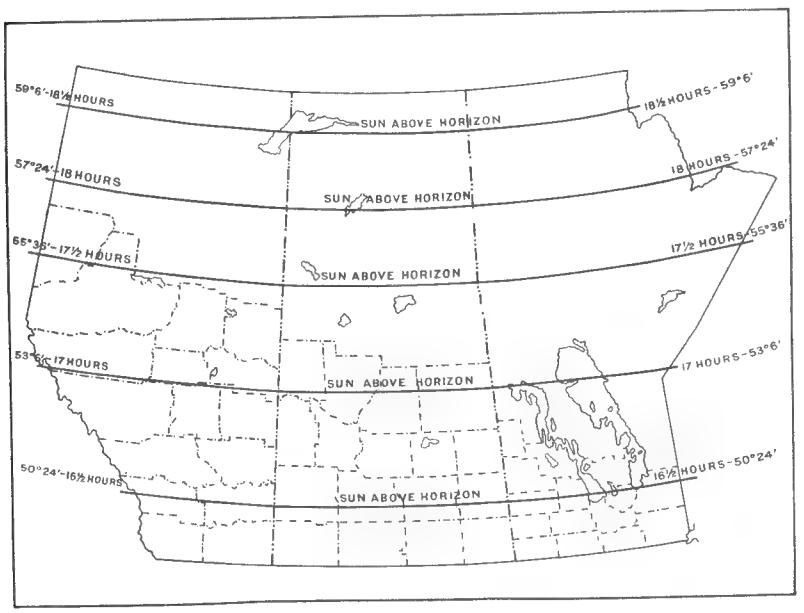


FIG. 128—Length of daylight on June 21 in the Prairie Provinces (*Statistical Atlas*).

Most of the Peace River district has a normal annual precipitation of less than 15 inches (Fig. 16). The precipitation declines as one follows the river to its mouth. Normal annual precipitation at Fort Vermilion is only 12.3 inches.[6] The normal precipitation in the warm season (Fig. 17) is less than 10 inches, but is lower at Beaverlodge (7.6 inches) than at Fort Vermilion (7.8 inches). Thus a larger proportion of precipitation falls in the growing season in the lower than in the upper valley. In general, the precipitation in the Peace River area is less than in the Park

[6] *Canada Year Book, 1931* (Ottawa: Dominion Bureau of Statistics, 1932), p. 64.

Belt to the south. No considerable part of the Peace River country has a warm-season rainfall of as much as 10 inches. Only a small part of the Park Belt has in these months a precipitation of less than 10 inches. Though records of evaporation are lacking, it seems probable that it is lower evaporation which promotes a parkland vegetation in parts of the Peace River Valley even though the precipitation is less than in the more southerly parkland areas.

TABLE X—OCCURRENCE OF FROST (32°F) AT DOMINION EXPERIMENTAL FARMS *

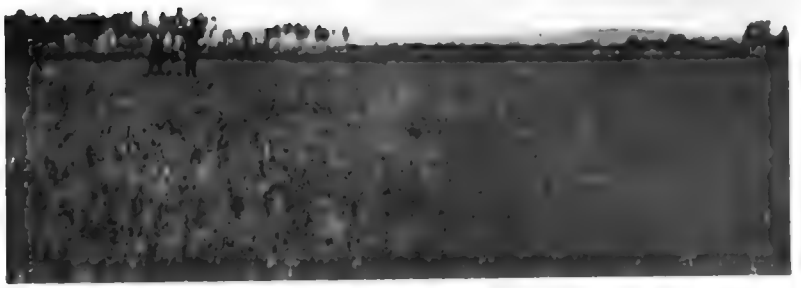
STATIONS	LENGTH OF RECORD	FREQUENCY OF SUMMER FROSTS		
		JUNE	JULY	AUGUST
Lethbridge	15 years	4	–	1
Lacombe	15 years	11	4	9
Beaverlodge	14 years	10	2	6
Fort Vermilion	16 years	10	1	5

* *Report of Dominion Field Husbandman, 1929* (Ottawa Department of Agriculture, 1920), p 9

Frost is a factor of importance, but perhaps not of the importance which the latitude of the Peace River country would lead one to expect. The upper valley has an average frost-free period (temperature above 29° Fahr.) of 95 to 105 days (Fig. 21). The growing season from the date of seeding to the first fall frost is 120 to 130 days (Fig. 22).

Records of the Dominion Experimental Farms show a frost-free period (here defined as temperature above 32° Fahr.) of 80 days in the upper Peace at Beaverlodge and of 88 days on the lower Peace at Fort Vermilion, as compared with periods of 69 days at Lacombe, Alberta, and 89 days at Scott, Saskatchewan, both south of 53° N.[7] The temperature at Fort Vermilion is undoubtedly modified by the presence of the river and by the low altitude of the river valley where the experiment station is located. The variations in temperature from place to place due to influences of altitude, soil, air currents, and water bodies are so great that it is difficult to generalize. The final test is the crop test. Throughout the area the early-maturing wheats, Garnet and Reward, are considered safe; Marquis involves greater hazards.

[7] *Op. cit.*, p. 9.



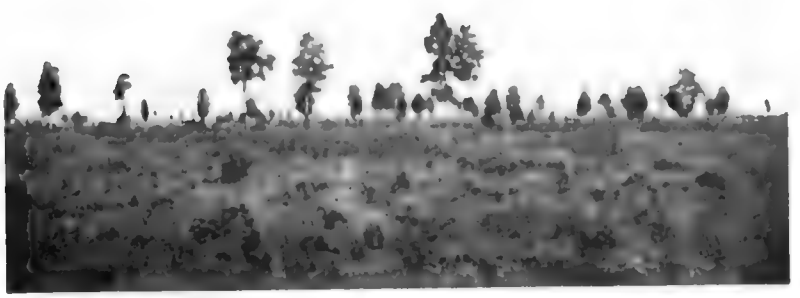


Fig. 129—A piece of virgin "prairie" north of the Peace (Alberta Soil Surveys).
Fig. 130—Virgin land at Sunset Prairie in the Peace River Block.
Fig. 131—Virgin land near Fort Vermilion (National Development Bureau).

Even where the average frost-free period is sufficient for the maturing of crops, the occurrence of summer frosts may seriously reduce the profitableness of farming. The interesting records of the Dominion Experimental Farms show the occurrences of temperatures of 32° F. or lower at four Alberta stations during the summer months. It is noteworthy that the frost hazard is greater at Lacombe, located over 400 miles south of Fort Vermilion in a farming area supporting a population of over 10 persons

Fig. 132—An Alberta soil survey party on virgin parkland west of Dunvegan. These soils have from 120 to 140 acres of arable land per quarter section. (Alberta Soil Surveys.)

per square mile, than at either Beaverlodge or Fort Vermilion in the valley of the Peace. August frosts, more injurious to crops, are less frequent in the north than June frosts (Table X).

Even from the inadequate frost data available, it may be concluded that, though frost hazard will continue to influence farming practice and the selection of field crops, it does not in itself seriously limit the extension of agricultural settlement in the Peace River Valley. Satisfactory settlement where other features are favourable is evidence of this.

The Peace River Valley is a mixed woodland and grassland

FIG. 133—Soil map of the Peace River Valley between Dunvegan and the Peace River Block (facsimile of the map accompanying the report cited in footnote 10). Scale of this reduction, 13½ miles to the inch. The better soils appear in the darker tints designated A2 (parkland) and W1 (first-class wooded).

(Fig. 23). The earliest and most satisfactory settlements began on open parkland areas. These are grassland areas broken by "bluffs," and on the outer edges covered with a light forest cover of poplar and light spruce (Fig. 130). These are the "prairies" so prominent in the place-names of the district.[8] The lightly wooded circumferences of the "islands" of parkland are surrounded by belts where the forest cover is heavier and has a larger proportion of spruce, with jack pine on the sandy ridges and willows in the swamps. The upland areas (chiefly moraines) are the most heavily wooded, and here clearing is an expensive and profitless occupation.[9]

As has already been indicated in the preceding chapter, the better soils of the Peace River are of the transitional black park and grey timber type (Fig. 139). Wyatt and Younge write of a characteristic Peace River section (Fig. 133):

> The parkland areas contain the best soils of the surveyed area. In general they are not true parkland (black) soils, but have been partially degraded by the timber growth which has or is at present occupying these soils.
> . . . The better class of wooded soils occur as a transition belt adjacent to and surrounding the parkland soils. These merge into a poorer class of wooded soils found usually on the rougher topography. The parkland soils have been found on the plateaus adjacent to the drainage course as well as on some of the alluvial plains.[10]

The parkland soils of the north are about equal in quality to those of the Edmonton district, though the phosphorus content is less. The wooded soils are similar to those which have been described in the preceding chapter.

It has been estimated on the basis of the provincial surveys and of the Dominion land-classification surveys, that in the Alberta section of the Peace River Valley—excluding certain muskeg, eroded, and rough areas—there are 12,600,000 acres of land, of which 1,437,000 acres (11 per cent.) are black park soils, 1,689,000 acres (13 per cent.) are first-class wooded soils, 4,776,000 acres (38 per cent.) second-class wooded soils, and 4,692,000 acres (38 per cent.) third-class wooded soils.[11]

In the Peace River Block of British Columbia (3,500,000 acres)

[8] For example, High Prairie, Little Prairie, Big Prairie, Grande Prairie, Sunset Prairie, Rose Prairie, the Battle River Prairie, the Keg River Prairie, etc.

[9] See above, p 138.

[10] F. A. Wyatt and O. R. Younge, *Preliminary Soil Survey Adjacent to the Peace River, Alberta, West of Dunvegan* (Edmonton Research Council of Alberta, Soil Survey Division, Report 23, 1930), pp 23-4

[11] See Appendix, pp. 207-214, 217, 231.

only a limited soil survey has been made, but the land has been classified as grassland and land with light, medium, and dense forest cover.[12] Assuming, as is reasonable, that these groups correspond roughly with park, first-, second- and third-class wooded soils respectively, it may be estimated that the areas of the soil divisions are as follows: black park soils, 284,000 acres (8 per cent.), first-class wooded soils 331,000 acres (9 per cent.), second-class wooded soils 646,000 acres (18 per cent.), third-class wooded soils 2,239,000 acres (64 per cent.).

Surrounding the Peace River Block on south, west, and north are unsurveyed areas which lie within the Great Central Plain and may contain significant quantities of agricultural land. Southward, approaching the Rockies, altitudes of more than 3,000 feet and rough topography place narrow limits to the possibility of agricultural land. Westward, beyond Hudson Hope, high foothills and mountains preclude any considerable agricultural settlement. Northward, in the valley of the Beatton River (a tributary of the Peace), altitudes of 2,200 feet and light forest cover give promise of significant areas of good wooded soils between latitudes 56° 40′ and 57° 20′.[13]

The government of the province of Alberta has been advised by its soil experts that parkland soils and first-class wooded soils "are sufficiently fertile to insure satisfactory crop returns", and that second-class wooded soils "justify settlement even though they are considered to be marginal lands".[14] On this basis there are in the Peace River Valley east of the Rocky Mountains upwards of 3,741,000 acres suitable for cultivation, and 5,424,000 acres marginal for cultivation—a total of 9,165,000 acres suitable for settlement.

The Peace River Valley is an area of recent and active settlement. Most of the settled area has a rural population density of less than two persons per square mile (Fig. 49). In one or two spots densities of more than ten per square mile have been achieved. Densities of two per square mile or more are very closely correlated with the open parklands and their lightly wooded borders. One such parkland area stretches west along the north bank of the Peace from Grimshaw to Dunvegan, where

[12] See Map of Peace River Block, compiled from Land Classification and Reconnaissance Surveys, scale, 4 miles to the inch (Ottawa: Topographical Survey, Department of the Interior, 1928).

[13] Preemptor's Maps of British Columbia, scale, 3 miles to the inch, sheets 3E and 3Q (Victoria: Department of Lands, 1931). See also Appendix, p. 218. [14] Wyatt and Younge *op. cit.*, p. 31.

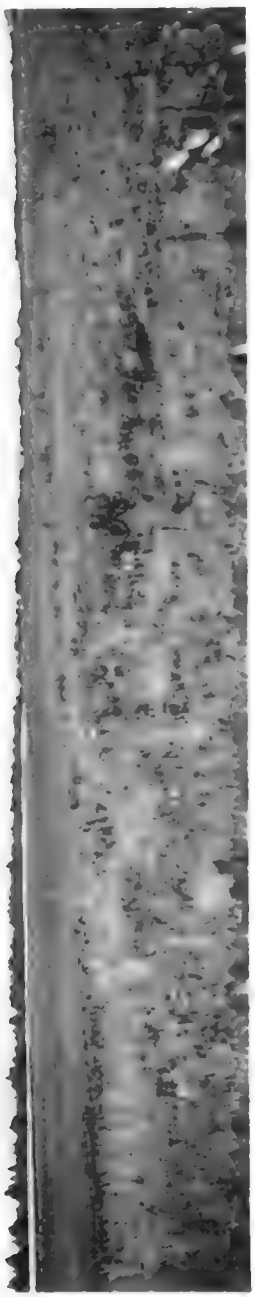


FIG. 134— (upper) Recently broken land near Dawson Creek in the Peace River Block. FIG. 135—Homestead on the Battle River prairie (Nottkewin).

Fig. 136—Well-settled country near Beaverlodge.

it crosses to the south bank to include the Spirit River "prairie" (Fig. 130). Further south the parklands of the Grande Prairie district support a rural population numbering more than two to the square mile. Smaller areas of the sort are shown on the population map at High Prairie at the west end of Lesser Slave Lake, west from the railway junction at McLennan, and in the Pouce Coupé district in the Peace River Block.

Meteorological information concerning the Peace River Valley is not sufficiently detailed nor are settlements sufficiently mature to disclose any close correlation between climatic factors and population density. Vegetation belts may, however, be deemed to reflect differences in climate, and, in the parts of the district settled first, the correlation between population and vegetation is close.

Settlement in this district is so recent and so immature that the ultimate distribution of population is not apparent. It may be predicted, however, that, unless restricted by transportation difficulties, population will attain higher densities on the parkland soils, and that accordingly the belt of higher density will extend along both banks of the Peace westward to link up with the similar settlements in the Peace River Block. The soil survey in 1929 of the district shown on Fig. 133 revealed 10,390 quarter sections (1,662,400 acres) of unoccupied lands recommended for settlement, in addition to 600,000 acres (27 per cent.) unfit for settlement. Of the total area, 413,000 acres (18 per cent.) were classed as park soils, 518,000 acres (23 per cent.) as first-class wooded soils, and 732,000 acres (32 per cent.) as second-class wooded soils.[15] Though this district is probably the best of the unsettled areas, it is not superior to the better settled districts. The amount of land not suited to agriculture (27 per cent.) compares more favourably than one might expect with the proportion of unsuitable land in the Prairie Plains belt (24 per cent.) and in the Park Belt (52 per cent.). Soil conditions will apparently not prevent the building up of settlements in the Peace River Valley of a density sufficient to support the necessary governmental and social services.

The character of the Peace River country has long been known. The fur traders entered it before the nineteenth century. The fur trading post was established at Dunvegan more than 100 years ago. In 1879 Dr. G. M. Dawson explored the country in

[15] Wyatt and Younge, *op. cit.*, p. 31-33.

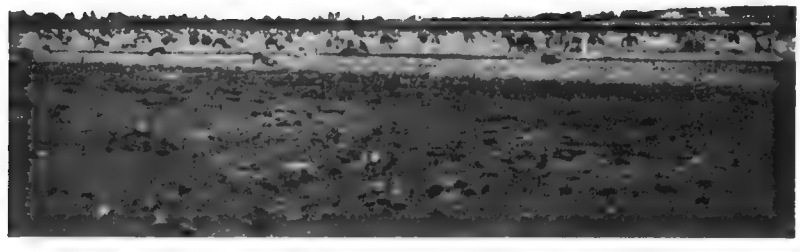


FIG. 137—Fresh breaking in a Peace River district (National Development Bureau).

FIG. 138—A new home on the Battle River prairie. Note the level topography, open country, and log house.

FIG. 139—Cultivated parkland soils in a Peace River district. Note the black soil in foreground and the wheat stooks beyond.

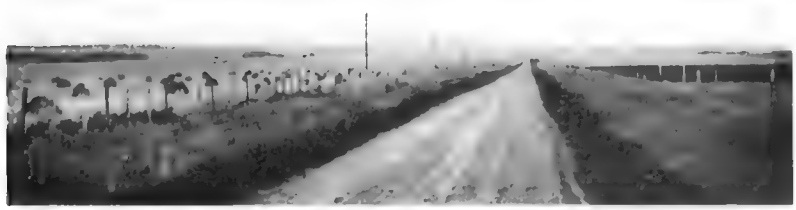


FIG. 140—Provincial highway connecting the settlement at Notikewin with the railway 50 miles to the south.

FIG. 141—A highway in the Peace River Block, B.C.

FIG. 142—Rolling park lands between Pouce Coupé and Rolla, B.C.

connection with the Canadian Pacific Railway surveys, and reported the existence of more than 16,000,000 acres of "good" land.[16] In 1876 a sample of wheat collected during the previous year by Dr. John Macoun at Fort Chipewyan at the west end of Lake Athabaska (58° 43′ N) was awarded the bronze medal at the Philadelphia Centennial Exposition.[17] Agriculture was carried on for years around the missions and trading posts. In 1907 Fred S. Lawrence gave evidence before a committee of the Senate that his father had gone to Fort Vermilion in 1879 and had become interested

FIG. 143—Settlers' outfits setting out for the Battle River Prairie in 1929.

in agriculture. He himself had farmed there for more than twenty years. He testified that he had never had a complete failure from frost or any other cause.[18] Interest in the country was stimulated by the discovery of gold in the Yukon, since one of the Yukon trails crosses the Peace River country.[19] Evidence was given that there had been ranching in the Grande Prairie district as early as 1900, and also at Spirit River.[20] Ten thousand acres on the valley bottom at Peace River Crossing were reported to be occupied in 1904.[21]

These were, however, but beginnings which were slow in bearing fruit. In the Peace River country was re-enacted the history of prairie settlement generally. Settlement languished in part

[16] See above, p. 40.
[17] *Journals of the House of Commons, Canada*, Appendix 4, Vol. XLII, 1906-7, p. 26.
[18] *Journals of the Senate of Canada, 1906-7*, Vol. XLII, Appendix 1, pp. 91-94.
[19] *Ibid.*, pp. 26ff.
[20] *Ibid.*, p. 87.
[21] *Appendix to the Journals of the House of Commons of Canada*, Vol. XXXIX, 1904, p. 351.

because railways were lacking, and in part because early-maturing grains were not available.[22] In 1903, James Macoun, Dominion Botanist and son of John Macoun, reported that, though in sheltered valleys and at the lower altitudes agriculture was possible, it could not be carried on safely on the high plateau. His evidence is very similar to that given by Sir George Simpson concerning the Hudson's Bay Company's territories in 1856.[23] As the development of Red Fife wheat enabled settlement to get a start on the Canadian prairies, and as Marquis wheat gave stability, so the development of Marquis wheat permitted settlement of the Peace River Valley, and the recent emergence of Garnet and Reward wheat has consolidated settlements.

> That the soil is excellent and much of it available for immediate use cannot be denied, but the occurrence of severe frost on the plateau when the grain is not far enough advanced to resist its effects, may, as far as our experience goes, be considered a certainty in the majority of seasons [24]

A considerable group of settlers migrated to the Grande Prairie district in 1908, and the population map for 1911 (Fig. 45) shows a considerable area of settlement stretching across the river at Dunvegan, and a small patch of occupied land at Grande Prairie. These early settlers had to wait until 1915 for the coming of the railway. By 1916, the whole of the Grande Prairie district had been invaded, and the land along the railway between Lesser Slave Lake and Peace River Crossing had been taken up (Fig. 46). The railway and high prices for agricultural produce stimulated settlement, so that by 1921 population had pushed out on all sides from the nuclear settlements and had entered the Peace River Block (Fig. 47). At that date the railway (Fig. 38) had been built north to Peace River Crossing, while another branch extended south of the river to Spirit River and Grande Prairie. Between then and now (Fig. 40) the north branch has been extended about 65 miles west, and the south branch has been pushed through to Dawson Creek in the Peace River Block. A highway has been constructed north from Edmonton admitting motor traffic to the Peace River, and an important colonization road has been built north from Grimshaw to the Battle River prairie at Notikewin (Figs. 121 and 140).

A large part of the settled area of the Peace River Valley is

[22] See Vol. II in this series.
[23] See above, pp 28-29.
[24] Cited in *Appendix to the Journal of the House of Commons of Canada*, Vol XXXIX, 1904, p 346.

more than ten miles from a railway (Fig. 40), but the more densely settled areas and the bulk of the population are within the railway belt. Settlements more than ten miles from the railway have not attained a population density of more than two persons per square mile (Fig. 49). In some cases distances from the railway are extreme. The Notikewin settlement (57° N.) is 50 miles from the railway, and some settlements in the British Columbia part of the valley are from 25 to 75 miles. Roads in these sections (Figs. 140-143) are inadequate substitutes for railways, and the limitation of transportation facilities is as important a factor as the limitation of soils in setting the bounds of settlement.

Utilization of land in the older settlements of this northern area is very similar to that in the Edmonton district. In the open country from Grimshaw to Fairview (north of the Peace), at Spirit River, and in the Grande Prairie district, wheat growing is the most important use of land. Forty to seventy per cent. of the field crop acreage is devoted to wheat (Fig. 54), while 20 to 40 per cent. is devoted to oats (Fig. 55). On the wooded soils and on the land outside the railway belt, the percentage of oats is much greater, ranging from 40 to 100 per cent. The change in land utilization over the past decade has been striking. Municipalities in 1926 using from 40 to 70 per cent. of the field crop acreage for wheat, in 1921 used only 30 to 50 per cent. Whereas in 1926 oats used only 20 to 40 per cent., in 1921 it used from 40 to 60 per cent. Growing maturity of settlement, improvement of transportation, and the introduction of early-maturing wheats has added the park soils of the Peace River Country to the spring-wheat region.

Farms in the older settlements of the Peace River yielded in 1925 about the same income from field crops (Fig. 110) as did those of the Edmonton district, though the Peace River farms were larger (Fig. 72). The income from animal products was, however, only about half that of Edmonton farms (Fig. 111).

CHAPTER IX

CLIMATIC VARIABILITY

THE western plains of Canada constitute a region not only of recent and advancing settlement but a region in which successful settlement has become possible only since the development of early-maturing wheats and of dry-farming practices. Agriculture is carried on close to the minimum conditions

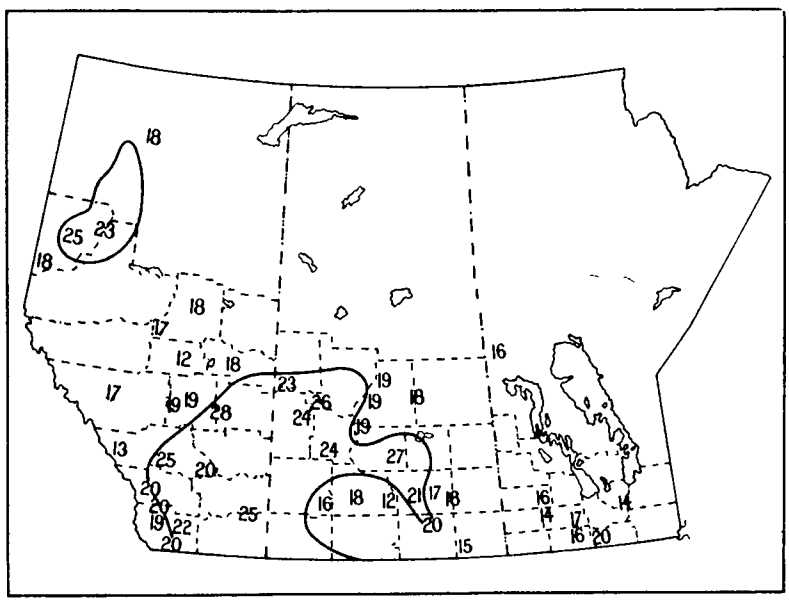


FIG. 144—Variability of annual rainfall (based on data in the monthly reports of the Dominion Meteorological Service). The map portrays degrees of variability and is generalized from calculations for approximately 100 stations. Records of less than 15 years were used only for interpolation The average variation from the mean is expressed as a percentage of the mean The solid line represents a degree of variability of 20 per cent

requisite for its success. Over the greater part of the region it is necessary to conserve moisture, and in considerable areas early-maturing grains and speed in farm operations are necessary to avoid the penalties of a short growing season. The margin of safety in both cases is comparatively narrow.

It follows, therefore, that the *reliability* of the occurrence of

rainfall and of frost is of the utmost importance. Average or so-called normal conditions may be favourable, but, where the margin of safety is narrow, deviations from the average may be such as to make agriculture unprofitable. So important is climatic reliability that the farmer on the Canadian plains habitually calculates in terms of probabilities. Latterly, of course, the risks of price changes have been of first importance, but the risks of

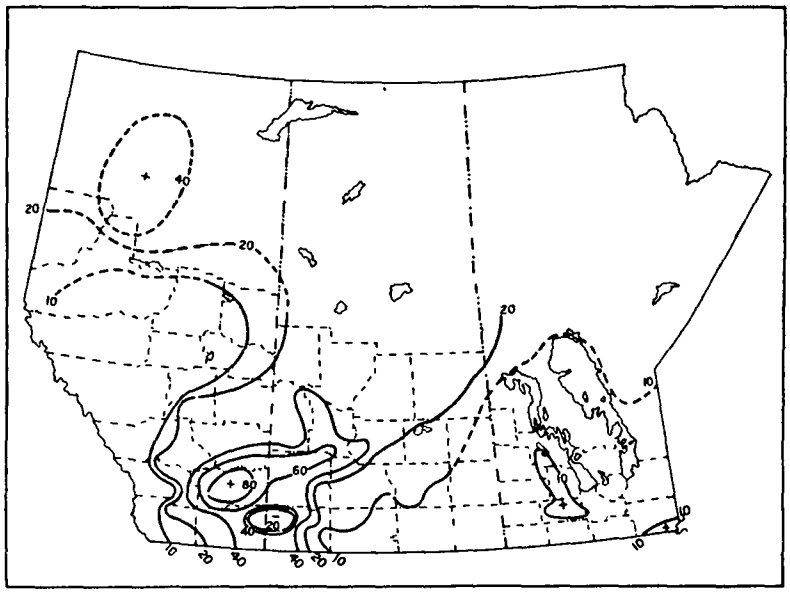


FIG 145—Relative number of years in which annual rainfall was less than 12 inches (based on the same source as Fig. 144). The figures shown on the map are percentages. In the construction of the map records of less than 15 years were used only for interpolation Over 100 stations have relatively good records and the map gives a good picture of conditions.

good or bad years form a consistent background for the wheat farmer.

In a region of sub-humid or semi-arid climate, rainfall is of first importance. Figures 16 and 17 show the normal distribution of precipitation over the region. It is greatest in the areas about Winnipeg and Edmonton and along an arc passing through these points. It is lowest in the southwest, just west of the Alberta-Saskatchewan boundary. The degree of aridity represented in Figure 19 is, however, least in eastern Saskatchewan and in Alberta northwest of Edmonton where summer temperatures are lower than in the Red River Valley.

Figure 144 depicts the reliability of annual precipitation. It will be observed that the reliability decreases as one moves from the sub-humid to the semi-arid areas. As against an average variation of 14 per cent. at Winnipeg and 12 per cent. at Edmonton, the average variation at Medicine Hat is 25 per cent. The area having average variations of more than 20 per cent. corresponds closely with the area having less than 15 inches annual

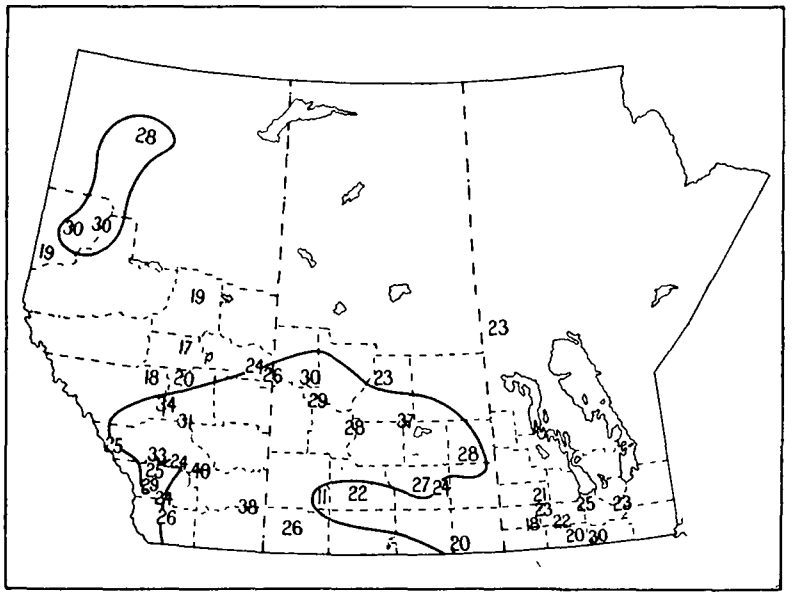


FIG 146—Variability of warm-season rainfall, April 1 to September 1 (based on data in the monthly reports of the Dominion Meteorological Service) The average variation from the mean is expressed as a percentage of the mean The solid lines represent a degree of variability of 25 per cent

precipitation and also with the outlines of Palliser's Triangle (see Fig. 28). Broadly speaking, the areas of scanty rainfall have the least reliable rainfall. Griffith Taylor considered that in Australia precipitation of less than 20 per cent. variability was "reliable".[1] Though other conditions such as the rate of evaporation are doubtless very different from those of Australia, the area of more than 20 per cent. variability in precipitation is a "problem area" in the Prairie Provinces.

Figure 144 shows the variability of precipitation as measured by percentage deviations from the mean. It is not clear, however,

[1] Griffith Taylor, *Australia in Its Physiographic and Economic Aspects* (Oxford 1928), p. 64.

that *relative* variability is the most significant fact. The margin of safety is greater in some areas than in others. An attempt has been made, therefore, to measure the same phenomena by another method. It is known that the district in southeastern Alberta, which has less than 12 inches annual precipitation, is distinctly marginal agriculturally. It is assumed, therefore, that over the whole region except in the lower Peace River Valley,

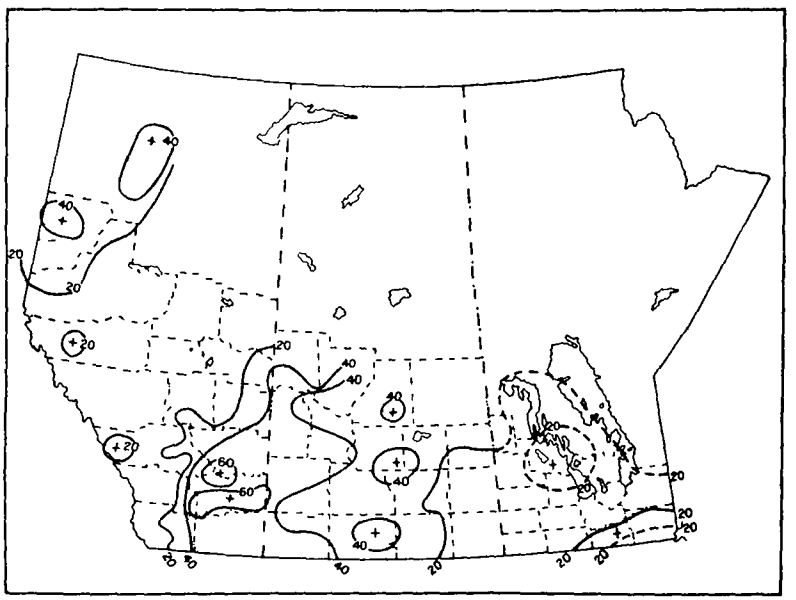


FIG 147—Relative number of years in which warm-season rainfall, April 1 to September 1, was less than 7.5 inches (based on the same source as Fig 146). The figures shown on the map are percentages. In the construction of the map records of less than 15 years were used only for interpolation. Over 100 stations have relatively good records and the map gives a good picture of conditions.

annual precipitation of less than 12 inches is insufficient for the production of crops. Figure 145 records the relative number of years in which annual precipitation was less than 12 inches. This map shows the frequency of rainfall deficiency rather than rainfall variability. In general, however, it tells a story similar to that of Figure 144.

The variability of warm-season precipitation is greater than that of annual precipitation (Fig. 146), but the two maps show the division of the country into roughly similar belts. As 12 inches was taken as a critical annual precipitation, so 7½ inches was selected as a critical warm-season precipitation, and Figure 147

depicts the frequency of deficiencies in warm-season precipitation. The belts shown on this map are generally the same as those shown on Figure 145.

The same phenomenon is recorded in another way in Table XI. The difference between the highest and the lowest annual precipitation recorded for a twenty-year period is shown as a percentage

TABLE XI—YEARS OF HIGHEST AND LOWEST RAINFALL FOR TWENTY-YEAR PERIOD 1910-1929 (INCL.), FOR SELECTED STATIONS

A STATIONS IN AREA SHOWN ON FIGURE 144 AS HAVING RAINFALL VARIABILITY OF MORE THAN 20 PER CENT

STATION	LOW	YEAR	HIGH	YEAR	RANGE	RANGE AS % OF MEAN
Lethbridge	8 0	1910	25 9	1916	17 9	111 9
Medicine Hat...	7 5	1910	25 3	1927	17 8	140 1
Swift Current .	10 1	1910	24 0	1916	13 9	95 2
Waseca .	7 1	1918	22 6	1916	15 5	116 5
Calgary. ...	9 1	1918	29 8	1927	20 7	121 0

B STATIONS IN AREA SHOWN ON FIGURE 144 AS HAVING RAINFALL VARIABILITY OF LESS THAN 20 PER CENT

STATION	LOW	YEAR	HIGH	YEAR	RANGE	RANGE AS % OF MEAN
Banff. . .	16 0	1919	25 2	1916	9 2	50 3
Edmonton....	13 8	1922	25 3	1914	11 5	65 0
Moose Jaw .	10 1	1929	20 8	1921	10 7	71 3
Alix.. . .	10.9	1913	23 1	1916	12 2	73.5
Prince Albert	7 4	1910	25 4	1921	18 0	118 4
Qu'Appelle .	12 1	1929	27 2	1921	15 1	77 0
Indian Head. ..	13 5	1929	26.0	1923	12 5	68 3
Saskatoon. ..	10 5	1915	21.3	1927	10 8	73 0
Treherne.. ...	11 6	1917	26 7	1926	15 1	74 4
Winnipeg.....	13 8	1917	25 1	1919	11 3	57 9
Minnedosa .	10 8	1929	22 3	1911	11 5	67 6
St. Albans.....	13 7	1917	28 8	1911	15 1	76 3

of the mean. The evidence of this table is in general accord with that of Figure 145.

This series of maps amply confirms the statement that variability of precipitation and the frequency of its deficiency increases as one moves from the sub-humid to the semi-arid belt. The district along the Alberta-Saskatchewan boundary which is characterized by a low percentage of land occupied, a low density of

population, low crop yields, a high proportion of abandoned farms, and range densities of sheep and cattle (Figs. 49, 41, 70, 75) is conditioned not only by a scanty rainfall but by a highly variable rainfall.

The effectiveness of rainfall is limited by the degree of evaporation. Not only does the degree of evaporation vary from place to place but it is subject to variation from year to year. Though closely related to the degree of cloudiness, evaporation varies

TABLE XII—PRECIPITATION AND OPEN PAN EVAPORATION, BROOKS IRRIGATION EXPERIMENT STATION, APRIL 1 TO SEPTEMBER 30*

YEAR	PRECIPITATION (inches)	EVAPORATION (inches)
1918	3 81	42 86
1919	8 46	31 44
1920	4 97	25 98
1921	8 26	27 62
1922	8 44	23 77
1923	9 49	23 27
1924	7 54	24 40
1925	10 98	22 31
1926	7 21	23 84
1927	15 74	16.29
1928	8 92	19.18
Mean =	8 53	Mean = 25 54
Average Deviation from the Mean Per Cent. =	23 4	= 18 4

* *Annual Reports of the Dominion Water Power and Reclamation Service*, 1924-1929 (Ottawa Department of the Interior).

also with the winds, and hot dry winds, with the consequent high evaporation, are a distinctive feature of "bad years" in the semi-arid belt. Unfortunately, no comprehensive records of evaporation in the Prairie Provinces exist. The degree to which it is a variable factor, however, can be gauged from the following record (Table XII) at the Brooks Experiment Station situated near the most arid section of Alberta. Though evaporation is somewhat less variable than precipitation, it is markedly variable and intensifies the effect of the unreliability of rainfall.

Where the available moisture is highly variable, crops are also subject to great variations. Figure 149 records the degree of variation of wheat yields in the various crop-reporting districts

of the three provinces. Since the yields are averages for the crop-reporting districts, the full degree of variability in the individual farmer's wheat yields is not disclosed. It is clear that, as would be expected, the areas of unreliable precipitation are also areas of unreliable crop yields and, in consequence, of highly variable farm incomes. The significance of this is more clearly realized when it is considered that over the whole of the three provinces in 1925 the sale of cereals contributed more than 80 per cent. of the farm income (Fig. 110 in relation to Fig. 109), and that in the areas of highest variability of crop yields wheat represents 80 per cent. or more of the field crop acreage (Fig. 54).

In a region in which rainfall is normally deficient it is to be expected that there would be a very high degree of correlation between crop yields and the amount of available moisture. Because of the amounts lost by evaporation, surface run-off, and percolation to lower soil levels, and also because rainfall is recorded for particular points, while crop yields are reported in averages covering districts of considerable area, so high a degree of correlation would not be expected between total precipitation at the nearest meteorological station and crop yields for the surrounding district. In Table XIII are shown the total amounts of precipitation recorded from April 1 to August 31 and for the months of September and October of the previous year, and also the average yields of wheat for the districts of Medicine Hat and Edmonton. The coefficient of correlation for the Medicine Hat district is relatively high (0.71), while that for the Edmonton district (0.2) is too low to be of significance. It was found that the correlation between precipitation for the above months and wheat yields was higher than where precipitation for any other period was taken.

The difference between the two districts is striking, but is merely a confirmation of other evidence that moisture is *the* limiting factor in the Medicine Hat district while it is only one of many in the Edmonton district. Other calculations not reproduced here indicate that these points are representative of the sub-humid and semi-arid belts. In the former, rainfall is fairly reliable (16 per cent.), and crop yield variations are not closely correlated with rainfall. In the latter, rainfall is highly unreliable (34 per cent.), and crop yields are closely correlated with it. It is, of course, probable that more detailed analysis of conditions in

the sub-humid belt would show that crop yields were closely related to the times at which rainfall occurred and other such circumstances. In the semi-arid belt the relationship is simple, direct, and easily perceived.

TABLE XIII— RELATION BETWEEN PRECIPITATION (APRIL 1 TO AUGUST 31, AND FOR PREVIOUS SEPTEMBER AND OCTOBER) AND WHEAT YIELDS*

YEAR	MEDICINE HAT		EDMONTON	
	PRECIPITATION (inches)	WHEAT YIELD† (bushels per acre)	PRECIPITATION (inches)	WHEAT YIELD† (bushels per acre)
1905	8 2	15 9	14 5	23 1
1906	9 8	18 5	12 7	24 7
1907	4 7	11 2	15 0	14 2
1908	8 9	5 3	11 0	19 4
1909	8 3	22 8	11 9	20 6
1910	5 4	7 0	9.8	21 6
1911	11 4	18 2	19 0	22 9
1912	8 5	15 6	17 6	22 0
1913	11 8	11 4	16 5	21 8
1914	4 8	5 1	17 5	23 7
1915	16 1	40 5	19 2	27 5
1916	15 6	24 6	13 8	22 0
1917	5 8	17 0	12 8	21 9
1918	8 0	3 1	12 7	10 3
1919	4 2	3 1	9 4	30 0
1920	7 2	8 8	15 7	36 3
1921	8 6	8 8	11 5	23 9
1922	9 8	9 8	9 8	18 7
1923	11 6	11 5	13 6	25 1
1924	4 7	8 5	13 8	29 0
1925	10 7	16 2	12 7	25 6
1926	9 7	15 2	16 6	23 8
1927	21 9	31 3	14 2	27 9
1928	8 3	22 5	14 2	22 8
Average (7 months)	9 3	14 7	13 9	23.3
Average Deviation (per cent.)	34	47	16	16

* *Annual Report of Dominion Water Power and Reclamation Service, 1928-29* (Ottawa. Department of Interior, 1931), pp. 99-100.

† Wheat yields for adjoining provincial electoral districts.

To quote from a recent report of the Water Power Service:

Under average dry farming conditions, it has been broadly estimated from the crop returns for twenty years at Calgary, Lethbridge, and Medicine Hat

that each inch of annual precipitation between six and eighteen inches represents about 2.25 bushels of wheat per acre in a crop year, thus:

Annual Precipitation	Average Crop
8 inches	4 5 bushels
10 "	9 0 "
12 "	13.5 "
14 "	18 0 "
16 "	22 5 "
18 "	27 0 "

These figures are slightly less than those indicated by the experimental irrigation records at Brooks, where the corresponding average is about 2.7 bushels per inch, the difference being chiefly due to the greater efficiency of controlled distribution.[2]

To such an extent does precipitation, and particularly variability of precipitation, fix the limit of crop production in the semi-arid belt, that it is stated that within this area "it is barely one year in ten that natural precipitation can produce results approaching those obtained by irrigation."[3]

It is a matter of frequent comment that dry years do not come singly. At Medicine Hat the rainfall was less than average from 1917 to 1921, and it was not until 1925 that a better than average crop was harvested. From 1925 to 1928 both rainfall and crops were much above average, but 1929, 1930, and 1931 were again bad years. A succession of good years encourages fresh enterprises in grain growing and induces the extension of existing enterprises, but it is difficult for any farmer to hold out through a succession of five poor years. Under such conditions it is only a farmer with large capital who can maintain himself long enough to average the results of good and bad years. The problem of the semi-arid belt must be attacked from two directions. Improvements in productive technique, better dry-farming practices, irrigation, etc., will reduce the fluctuations in production and in agricultural income. On the other hand, the economic and financial organization of the area and of its agricultural industry must be adapted to withstand wide fluctuations in the incomes of individuals and of the area as a whole. Just as a corporation with a highly fluctuating volume of business, such as one manufacturing railway equipment, must endeavour to build up large reserves and reduce fixed charges to a minimum, while a corporation

[2] *Annual Report of Dominion Water Power and Reclamation Service, 1928-29*, pp 48, 51.
[3] *Ibid.*, p. 51.

having a highly stable business, such as an electric power company, may safely have smaller reserves and a higher ratio of fixed charges, so the area shown on Figure 144 as having annual precipitation of more than 20 per cent. variability must in its industry and its communities endeavour to operate on low fixed charges and ample reserves.[4]

In the sub-humid section, and particularly along the northern margin, variability of precipitation is less important. Rainfall is more generous, the rate of evaporation is presumably less, reserves of subsoil moisture are retained longer in the spring by frost, and variability itself is much less than in the semi-arid belt. There are here, however, other causes of fluctuations in agricultural incomes, of which the most important is frost or variability in the length of the growing season.

As explained in an earlier chapter (p. 17), spring frosts are not of first importance in the spring wheat region. Spring tillage and seeding go on in spite of occasional frosts, and unless the frosts are very severe the young wheat plants are not greatly injured by frost unless they have reached an advanced stage of growth. The frost-free period (Fig. 21), therefore, is of minor significance in setting limits for profitable wheat growing, though it does show the relative positions of different districts. An attempt was made in Figure 22 to record the average length of the growing season as limited by the date of seeding and the first fall frost (29° F.). The date of seeding is obviously the beginning of the growing season. It is determined not only by temperature but by all the combined factors of environment. The significance of fall frosts is relative chiefly to the beginning of the growing season. Frosts which have no importance in years when seeding has been early and growth rapid may be of critical importance when the crops mature late.

Fluctuations in the length of the growing season are of great importance in increasing the risks of agriculture along the northern fringe. Unfortunately, seeding records are not sufficiently accurate nor available for a sufficient length of time to permit measurement of the variability in the length of the growing season. Some indication of the degree of variability may be obtained from Figure 148, showing the relative number of years in which temperature dropped to 29° F. or lower before September 1. Though

[4] See Volume IV in this series.

of only rough accuracy the map does show something of the relative probability of frost damage in the different sections of the region. In general the frost hazard is high where the drought hazard is low.

No information is available as to the quantities of wheat affected by frost each year, though it is a matter of common knowledge that the amount of frosted wheat marketed has de-

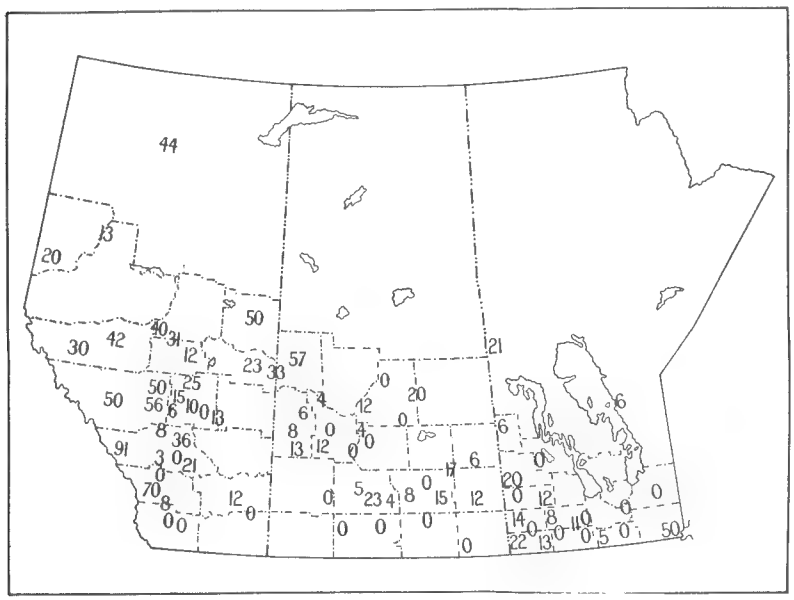


Fig. 148—Relative number of years in which the temperature fell to 29° F. or lower before September 1 (based on data provided by the Meteorological Service of Canada).

clined greatly throughout the whole period of settlement, and particularly since the introduction of Reward and Garnet wheat. Frost is one of the many factors, however, which make the wheat grown on the northern fringe inferior in grade to that grown in the semi-arid belt. The variability in the grade of wheat produced is, therefore, a valuable index of climatic variability. Information as to the grading of wheat by districts is available only for the province of Saskatchewan for the period 1917–1930. Figure 150 shows the degree of variation in the percentage of wheat grading No. 3 Northern or higher. Though the crop-reporting districts do not conform to climatic divisions, the pattern can be readily discerned. Average variations of 30 per cent. or more

occur in the sub-humid belt, while in the area of least rainfall the average variation is but 10 per cent. The semi-arid belt shows a relatively high variability of yield (Fig. 149) and a low variability of grade. In the sub-humid belt the situation is reversed; the yield is fairly dependable but the grade is unreliable.

Variability of climate affects the agricultural incomes of the Prairie Provinces in many ways more complicated and less direct

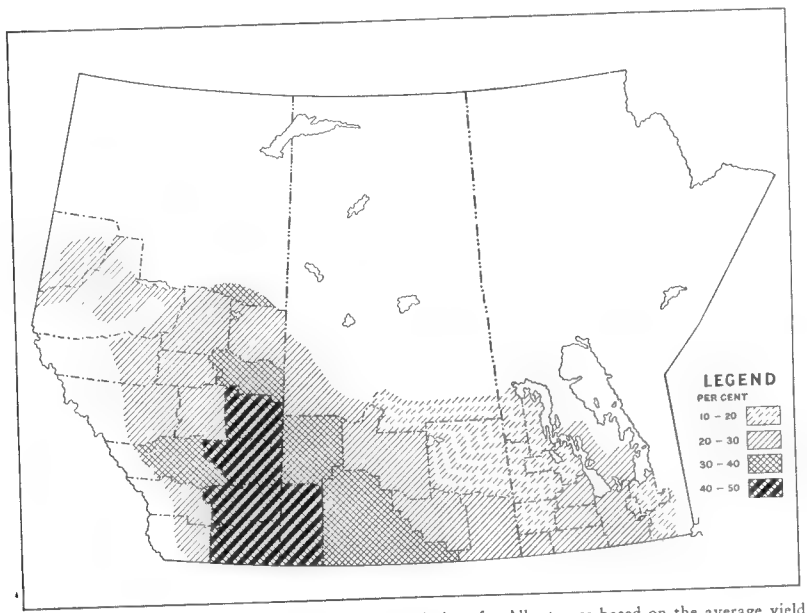


FIG. 149—Variability of wheat yields. The calculations for Alberta are based on the average yield per acre for the years 1921-1930 (incl.) for 17 census divisions, as reported in "Statistics of Progress" (Edmonton: Department of Agriculture, 1929) and on other data supplied by the Provincial Department of Agriculture. For Saskatchewan the data are calculated from "The Report of the Secretary of Statistics 1930" (Regina: Department of Agriculture, 1931) and cover average yields for 9 crop-reporting districts 1916-1930 (incl.). The Manitoba data are based on average yields for 14 crop-reporting districts 1922-1931 (incl.) as reported in "Agricultural Statistics by Crop Districts 1922-24 and 1925-29" (Ottawa: Dominion Bureau of Statistics, 1926 and 1930) and on additional data published in the "Monthly Bulletin of Agricultural Statistics" (Ottawa: Dominion Bureau of Statistics). For each territorial division the average variation from the mean is expressed as a percentage of the mean.

than those which have just been discussed. It is highly characteristic of the region, however, that in these particular instances the relationship should be direct and obvious, that to a greater degree than is common in an agricultural region history should be divided into "good" and "bad" years, and that the wheat crop should be the very centre of community interest.

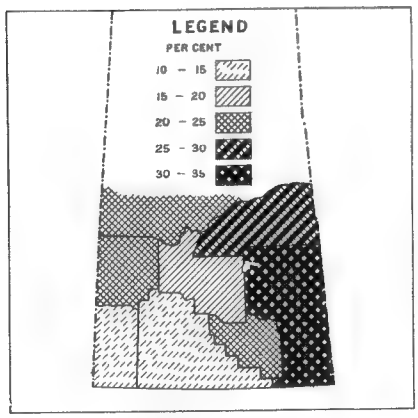


FIG. 150—Variability of wheat grades in Saskatchewan, 1917-30 (data from the *Annual Reports of the Secretary of Statistics*, Dept. of Agriculture, Regina). The calculations are based on the proportion of the crop in each of 9 crop-reporting districts which graded No. 3 Northern or better. The average variation from the mean is expressed as a percentage of the mean.

As shown in Table XIV fluctuations in gross agricultural revenue have over the past ten years been enormous. Even aside from the disastrous declines since 1929, fluctuations of 30 to 60 per cent. have been common. Gross revenue from farms in Saskatchewan for 1931 was little more than one quarter of that for 1928. Of course, only a part of this variability of income is to be imputed to climatic variations; the greater part of it is due to variations in the prices which the farmer receives for his products. Variations in price are economic phenomena, to be discussed elsewhere (in Vol. IV). It is sufficient to say here that the price of wheat like the prices of other raw materials is a highly variable one, but that the price received by the grower of wheat in Western Canada is still more variable because of the amount of the relatively fixed charges for handling, storage,

TABLE XIV—ESTIMATED GROSS ANNUAL AGRICULTURAL REVENUE, 1921-1931*
(in millions of dollars)

YEAR	MANITOBA	SASKATCHEWAN	ALBERTA
1921.....	97	258	121
1922.....	119	332	126
1923.....	87	304	187
1924.....	160	280	197
1925.....	142	416	246
1926.....	140	359	249
1927.....	117	404	326
1928.....	155	410	278
1929.....	119	299	223
1930.....	91	190	165
1931.....	52	107	135

* *Canada Year Book*, 1926 to 1932 (Ottawa: Dominion Bureau of Statistics).

transportation, selling commissions, etc., which must be deducted from the Liverpool price before the farmer's price is reached. The wheat farmer in Western Canada is engaged in a business subject to unusually sharp fluctuations, imposed on it in greater or less degree by pronounced variations in rainfall and the other climatic conditions of wheat growing, and by the necessity of competing in a far distant world market for the sale of a raw material. In these facts of a commercial agriculture in which a high degree of variability is inherent will be found the centre of the economic problems of Western Canada.[5] Much effort has been and will continue to be concentrated on reducing the degree of variability by restraining settlement in those areas subject to most violent variations, by extension of irrigation projects, by improved farming practice, and by the development of crops less susceptible to the hazards imposed by climate. On the other hand, agriculture in this region can never lose altogether its variable nature, and its economic institutions will tend in the future as in the past to turn to forms in which they can withstand the variations in income which they cannot avoid.

[5] See Volume IV in this series.

CHAPTER X

THE PROBABLE LIMITS OF SETTLEMENT

WHEN the transfer of the western plains to Canada was under consideration, narrow limits were set to the possibilities of settlements. Palliser excluded the "strong woods" on the north and the semi-arid plains on the south, leaving only the "fertile belt". Each succeeding authority has set wider limits to expansion, and each succeeding decade has seen population spread into hitherto prohibited areas.[1] Neither the "strong woods" nor the northward extension of the "Great American Desert" have been closed to settlement.

TABLE XV—NUMBER OF HOMESTEAD ENTRIES LESS NUMBER OF CANCELLATIONS*

(Years ending March 31)

YEAR	No.	YEAR	No
1926	285	1930	10,666
1927	−49	†1931	15,133
1928	−83	†1932	8,108
1929	9,525	†1933	5,215

* *Canada Year Book, 1931* (Ottawa: Dominion Bureau of Statistics, 1932), p. 1020. Information since October 1, 1930, from the provincial governments. From 1920 to 1925 cancellations exceeded entries in each year.

† Total entries. Record of cancellations not available.

Substantial northward progress has been made within the last few years. Land occupied in the three provinces increased by more than 20,000,000 acres or 23 per cent. between 1926 and 1931 (Table II, p. 58). This increase was occasioned almost entirely by the northward extension of settlement in the provinces of Saskatchewan and Alberta, and since 1931 the movement has continued.[2] Table XV, showing homestead entries, records the extent of this movement, since virtually all the homesteading has taken place along the northern fringe. The table makes clear that the increase in occupied acreage came mainly in the

[1] See Chapters II and IV

[2] In part the northward movement since 1931 has been associated with the abandonment of land in the semi-arid plains. The preliminary figures of the Census of 1931 indicate that the acreage of abandoned farms decreased between 1926 and 1931. Severe abandonment following the disastrous crop failure of 1931 is not recorded in these figures

latter part of the period from 1926 to 1931. Not since pre-war years has settlement been so active.

It is difficult to set limits to this northward extension of agricultural settlement. In a sense, there is no limit. There are geographical obstacles which improvements in the agricultural arts and favourable economic conditions may overcome. The general adoption of the early-maturing varieties of wheat, Garnet and Reward, by 1929 greatly stimulated northern settlement. Settlement promoted railway construction, which in turn gave fresh impetus to settlement. There is no question that a period of high prices for agricultural products would extend agricultural settlement and wheat growing far to the north. Settlement takes place for exceedingly diverse reasons, of which by no means the most important are economic; settlement *persists*, however, only if satisfactory incomes can be earned. Adverse physical environment, frost risk, inferior soil, scanty pasture, and long transportation hauls reduce incomes, but if prices are sufficiently high such reductions may be offset.

The geographical obstacles to the northward extension of agricultural settlement are (1) the short growing season and frost risks, (2) the scarcity of favourable soils in many areas, and (3) the cost of transportation.

In 1907 Sir Frederick Stupart, Director of the Dominion Meteorological Service, gave as his opinion that the line of 57.5° of mean summer temperature (June, July, and August) marked the boundary of "what might be considered absolutely successful agriculture . . . " He was not prepared to say that there might not be some kind of mixed farming carried on in the district north of this isotherm, but he was rather inclined to doubt whether you could depend on ripening wheat, for instance.[3] O. E. Baker selects 57° summer temperature as the northern limit of wheat growing.[4] C. E. Koeppe considers the summer isotherm of 58° to be a safer limit.[5]

J. F. Unstead in a notable article[6] fixed the northern limits of wheat growing in terms of accumulated temperatures above 5° C. for the growing season. He demonstrated that higher accumu-

[3] Report of Select Committee, Appendix No. 1, *Appendix to the Journals of the Senate of Canada*, Vol. XLII (1906-7), p. 121.

[4] O. E Baker, "Agricultural Regions of North America: The Spring Wheat Region", *Economic Geography*, Vol. 4 (1928), Fig. 159, p. 402.

[5] C. E. Koeppe, *The Canadian Climate* (Bloomington, Illinois: 1931), p. 115.

[6] "The Climatic Limits of Wheat Cultivation, With Special Reference to North America", *The Geographical Journal*, XXXIX (1912), pp. 347-366, 421-446.

lated temperatures are required at points where the mean temperature is higher and the duration of daylight shorter. Thus, while the required accumulated temperature at Dunvegan is esti-

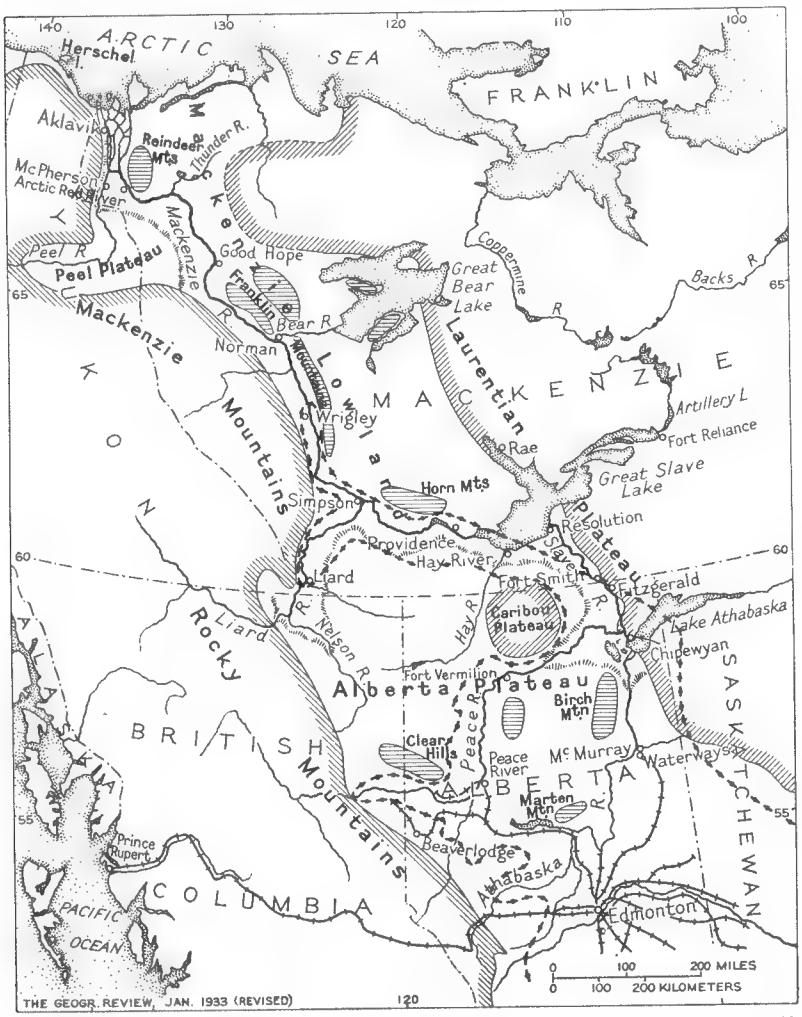


FIG. 151—Map of the Mackenzie Basin (modified from a map in the *Geographical Review*, Jan., 1933). The bold broken line represents Unstead's line.

mated to be 964° C., that at Dawson City is only 754° C. The climatic limit of wheat as drawn by Unstead is shown on Figures 57 and 151.

The Swedish geographer, Helge Nelson, fixed similar limits, viz., latitude 55° north of Lake Winnipeg and 62° on the Mackenzie River.[7]

Crop records indicate that these limits are probably well within the mark. At Beaverlodge, Alberta (Fig. 151), with a mean summer temperature of 56°, wheat is successfully grown at an altitude of 2,484 feet. W. D. Albright reported his own record in 1930.

In his sixteen years of experience he has never failed to ripen grain on the high land where he lives. His only very poor crops were in 1916 and 1924. In the former year, August frost reduced the yield of Marquis wheat to about nine bushels per acre in the field,—plots doing somewhat better. Even in that year oats on breaking were good for sixty or so. In 1924 drought and grasshoppers depressed field yields to about eight bushels of wheat. In 1918, it is true, a July frost caught much grain in the blossom, and a field on medium elevation yielded only about ten bushels per acre of very low grade, but higher slopes matured big yields. In 1922, when the April to August rainfall was only 3.57 inches, Ruby wheat on a measured acre of potato ground yielded twenty bushels.[8]

Robert F. Jones, who has farmed since 1889 at Fort Vermilion (latitude 58½° N. altitude 850 feet, and mean summer temperature 57.7°), reported that in his experience "no crop failure has

[7] Helge Nelson, "The Interior Colonization in Canada at the Present Day, and Its Natural Conditions," *Geografiska Annaler* (Stockholm: Svenska Sallskapet fov Antropologi och Geografi), V (1923), pp. 244-308.

[8] Quoted in F. H. Kitto, *The Peace River Country* Ottawa: Department of the Interior, 1930), p. 112.

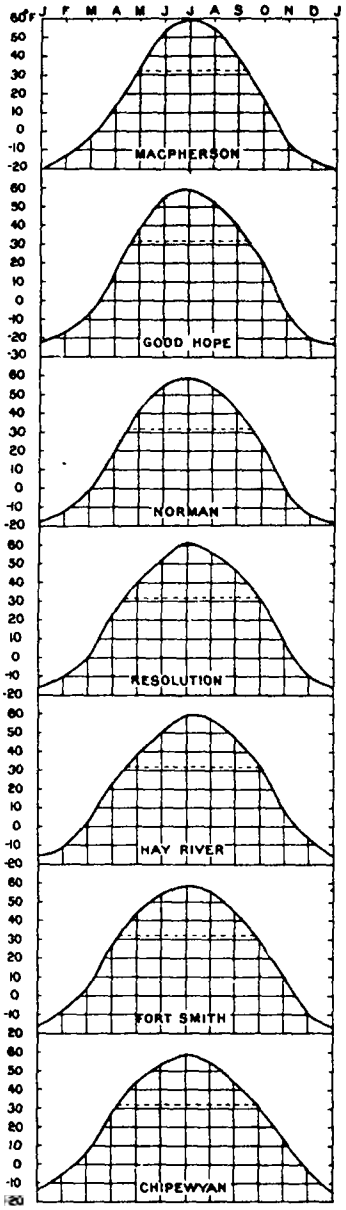


FIG. 152—Monthly mean temperatures at selected northern Canadian stations (based on data in *Canada Year Book, 1930*, pp. 54-55).

ever been known hereabouts".[9] For more than forty years a flour mill has been in operation at Fort Vermilion supplying the requirements of the Mackenzie Valley.[10] It will be noted that these records cover almost exclusively years before the introduction of the early-maturing Reward and Garnet wheats, and are in consequence understatements of possibilities. W. D.

FIG. 153—Cattle on mission farm near Fort Smith. Note the light clearing and good pasture (Dominion Lands Branch, Dept. of the Interior.)

Albright reports that wheat matured in 1930, 1931, and 1932 at Fitzgerald, latitude 60° N. and matured "patchily" at Hay River, 60 miles farther north (see Fig. 151), where the mean summer temperature is 55.7°.[11] At Simpson, north of 61° N., with a mean summer temperature of 58.3°, wheat had been reported as early as 1878 to ripen four years out of five.[12] To the southwest, at Liard, wheat and other grains were reported to be reliable

[9] F. H. Kitto, *op. cit.*, p. 113.

[10] *Ibid.*, p. 107, also Report of Select Committee, Appendix to the Journals of the Senate of Canada, No. 1, Vol. XLII (1906-7), p. 91.

[11] "Gardens of the Mackenzie," *Geographical Review*, Vol. XXIII (1933), pp. 9-11.

[12] D. M. Gordon, "Memorandum Regarding a Journey from Victoria, V.I., Across Northern British Columbia via Peace River Pass to Edmonton", Appendix 6, *Report and Documents in Reference to the Canadian Pacific Railway*, Sandford Fleming, Engineer-in-Chief (Ottawa: 1880), p. 102.

four years out of five.[13] Farther down the Mackenzie only small patches of wheat have been grown. In 1930 at Good Hope almost at the Arctic Circle, and with a mean summer temperature of 55.7°, Reward and Garnet wheat matured in eighty days, being "cut slightly on the green side." Oats and barley ripened 80 miles north of the Arctic Circle, and in 1932 good samples of

FIG. 154—Fort Smith (*Geographical Review*, Jan., 1933, from Royal Canadian Air Force).

barley and oats were produced at Aklavik, north of latitude 68° and only 60 miles from the Arctic Sea.[14]

These instances confirm Baker's limit of 57° mean summer temperature and Unstead's line as approximately accurate. Though wheat may be grown beyond this limit the risks are great. More quickly-maturing plants are, of course, grown far beyond this limit, and experience in the valley of the Mackenzie would indicate that

[13] *Ibid.*
[14] W. D. Albright, *op. cit.*, pp. 17-21.

FIG. 155 Simpson.

FIG. 156—Good Hope (Figs. 155 and 156 from *Geographical Review*, Jan., 1933, from Royal Canadian Air Force).

the July isotherm of 60° is an approximate boundary for all agricultural enterprises except grazing. These limits are also in general conformity with the experience in Alaska and Eastern Siberia.[15]

Unfortunately, there is nothing but the most scattered information concerning the length of the frost-free period in the Mackenzie Valley. Figure 152, however, indicates the shorter summers encountered in the higher latitudes of the Mackenzie Valley.

There is no question but that the rapid growth possible in the longer days of the northern summer offsets in part the ill effects of the shorter growing season. Garnet and Reward wheats mature in 121 days at Beaverlodge (Table III, p. 79). Albright reports wheat ripening at Fitzgerald with the same mean summer temperature as Beaverlodge in 95 days. At Fort Smith wheat ripened in 84 days, and at Good Hope in 80 days. Albright also reports the following record of growth of wheat at Simpson:[16]

	July 7	July 14	July 21	July 28	Aug. 4
Growth of wheat (in inches) .	11	+9½	+10½	+3	+1

It has been argued also that the danger of summer frosts in northern latitudes is reduced by the short period between sunset and sunrise, during which there is not time for the temperature to fall to freezing level. Dr. John Macoun in 1904 stated, "You can see where the days are constantly long there is no chance for frost, because the temperature cannot sink, and it is because the temperature cannot sink that there is no frost until the proper time for frost comes."[17] Dr. Vilhjalmur Stefansson argues similarly that:

> North of Edmonton through a belt of territory several hundred miles wide the danger of midsummer frosts does not increase greatly and may actually decrease, as one goes north. The chill which destroys wheat, for instance, develops slowly through the hours of darkness, and is usually most pronounced around dawn or sunrise. But somewhere a little north of Edmonton the period of darkness in midsummer begins to get so short that the chill does not have time to develop to the point where it destroys wheat. I do not mean that midsummer night frosts disappear but rather that they, temporarily at least, cease to become more numerous as you go north, and in fact become less numerous.

[15] *Pioneer Settlement* (New York: American Geographical Society, Special Publication No. 14, 1932) pp. 53 and 249. See also "The Climate of Northern Canada", *Canada Year Book, 1930*, pp 41-51.

[16] Information given by letter.

[17] Appendix to the Journals of the House of Commons of Canada, Vol. XXXIX (1904), p. 344.

for a space of several hundred miles—again premising equalities of topography, altitude, wind conditions, etc.[18]

Some evidence of this was given in Table X (p. 158), showing that the frequency of July and August frosts was less at Fort Vermilion than at Beaverlodge and less at Beaverlodge than at Lacombe. Some allowance must be made, however, for the fact that the altitude of Lacombe is 2,796 feet, that of Beaverlodge 2,484 feet, and that of Fort Vermilion 850 feet. Table XVI, showing the average minimum temperatures in July and August at stations in Alberta and the Northwest Territories from the United States boundary to the Arctic Circle, offers further corroboration.

TABLE XVI—AVERAGE NORMAL DAILY MINIMUM TEMPERATURES (F.)*

LATITUDE N	STATION	JULY	AUGUST
49°40′	Lethbridge	50	49
51°	Calgary	47	45
51°45′	Olds	46	42
52°25′	Lacombe	46	42
53°32′	Edmonton	49	46
55°15′	Beaverlodge	44	41
55°56′	Dunvegan	46	44
56°30′	Peace River Crossing	46	44
58°40′	Fort Vermilion	46	43
60°	Fort Smith	47	43
60°52′	Hay River	50	47
61°52′	Simpson	50	46
64°54′	Norman	47	43
66°15′	Good Hope	47	41
68°13′	Macpherson	49	43

* Data from *Canada Year Book, 1931* (Ottawa: Dominion Bureau of Statistics, 1932), pp. 48ff.

Soil conditions are limiting factors equal in importance to the length of the growing season. A first step in determining the possibilities of agricultural settlement may be taken by recalling that the Precambrian Shield (the "Laurentian Plateau" of Fig. 151) affords little basis for such settlement. It is true that where the development of mining and lumbering furnish a local market some agriculture will be attempted and will succeed. Local clay belts exist and swamps may be drained, but in general a satisfactory density of population cannot be built up on agricultural

[18] From a letter of Dr. Stefansson.

settlement alone. Such areas of agricultural land as do exist are too small and too scattered for secure settlement except in conjunction with other industries.

Very little is known of the character of the soils in the Mackenzie Valley below Great Slave Lake. Only small areas about the trading posts have been cultivated. The whole area lies within the sub-arctic forest zone, where one may expect to

FIG. 157—The edge of the sub-arctic forest, northeast of Great Slave Lake. Note caribou and scanty tree growth. (Dominion Lands Branch, Dept. of the Interior.)

find lightly podzolized and bog soils. Light rainfall and frozen subsoil have prevented leaching, while lack of drainage has created bogs and muskegs. The proportion of soil suitable for agriculture north of Simpson is probably very low. "In general it may be said that the greater part of this portion of the basin inland from the streams is made up of spruce muskegs with little or no drainage, and a permanent frost only a few inches below the surface, which would make farming impossible".[19] Evidence is universal that wherever ground is tilled the frost level recedes[20]

[19] Charles Camsell and Wyatt Malcolm, *The Mackenzie River Basin* (Ottawa: Canadian Geological Survey, Memoir 108, 1919), p. 41.

[20] Cf. Albright, *op. cit.*, p. 21; *Pioneer Settlement*, p. 52.

and that this obstacle to agriculture is much less serious than is often supposed.

Soil and climate indicate that agricultural settlement may push as far north as Simpson. The valley of the Liard has long been reported to have a better climate than that of the Peace, being more directly subject to the chinook influence. Settlers are already passing over from the Beatton River to the Nelson, a

FIG. 158—The arctic "prairies" in summer (Dominion Lands Branch, Dept. of the Interior).

tributary of the Liard. "Almost certain it is that, unless checked by legislative control, settlement will soon be crossing from the upper Peace to the headwaters of the Liard, pressing down that river, and probably meeting another vanguard working up from Simpson."[21]

No comprehensive information is available concerning the large area embraced by the Nelson, Liard, Hay, and Mackenzie Rivers. Soil reports on the Hay River country indicate a large proportion of swamps and muskeg which might in the future be worth draining, but not at present. It was estimated that not more than 20 per cent. of the Fort Vermilion-to-Hay-River area is suitable

[21] Albright, *op. cit.*, p. 15.

for settlement[22] and it is probable that soil conditions render an even smaller proportion of the larger area suitable.

Precipitation is scanty in the areas from Fort Vermilion north. Fort Vermilion has an annual precipitation of 12.28 inches, Simpson 13.5 inches, and Good Hope 10.3 inches. The warm-season rainfall (April to August) for these stations is respectively, 7.8 inches, 7.1 inches, and 5.2 inches.[23] These figures are comparable to those in the most arid sections of the dry belt. Apparently the conservation of moisture by frost in the ground prevents drought conditions from arising. Albright reports that at Fort Simpson frost tended to disappear in land which had been tilled for a long time and that drought conditions might arise.[24]

As already indicated, the boundary of the Precambrian Shield, the summer isotherm of 57°, or Unstead's line, and the inferior quality of the northern wooded soils place the boundary of potential agricultural land much farther south in Saskatchewan and Manitoba than in Alberta. Though adequate meteorological records are lacking, it is probable that limitations of soil become effective farther south than do limitations of summer temperature and of the growing season. Progress into the true wooded soils is not likely to be effected. In both provinces there exist considerable areas which under favourable economic circumstances might be drained and converted to agricultural uses. Such areas are particularly important east and north of the lakes in Manitoba.

Inadequate transportation offers the third limitation to the northern extension of settlement. This is a secondary rather than a primary limitation, for, were other factors sufficiently favourable, transportation would be provided, though distance from markets would still be great. The other factors are, however, only moderately favourable. There is a basis for settlement but not for dense settlement. It is a characteristic of much of the good land of the northern fringe that it does not occur in compact blocks, but is interspersed with a high percentage of poor land. The provision of transportation is, therefore, difficult unless other industries can bear most of the cost, or unless, as in the case of many of the present northern railways, the cost is borne by the country as a whole rather than by the traffic created.

In the valley of the lower Peace and in the Mackenzie Valley

[22] See Appendix, p. 207.

[23] *Canada Year Book, 1931*, pp. 63-4.

[24] Information given by letter

water transportation is all that is available, and settlements are therefore restricted to the river banks. From Fort Vermilion north agricultural produce is not shipped south to central markets but north to the posts of the Mackenzie Valley. In 1917 a shipment of wheat was made up the Peace by boat to Peace River Crossing and thence by rail to Fort William. Such a shipment, however, was only possible in a period of abnormally high prices.

Where other industries provide a local market for agricultural produce, high transportation costs furnish effective protection to the local farmer. Albright reports high prices at the Mackenzie River posts. At Simpson in 1930 flour sold for $16.00, and boys commanded wages of $5.00 a day. At Good Hope flour sold for $20.00 a bag. Prices of other products were proportionately high.[25] Local farming and gardening enterprises are therefore carried on under extremely favourable price conditions. Improvement of transportation would injure rather than benefit local agriculture. Nelson reports that limits of cultivation in Scandinavian countries are moving south because of better rail communication.[26]

Extended settlement in Saskatchewan will push north in a pattern more or less continuous with the older settlements, except for small patches at mission and trading posts. In northern Manitoba mining and electrical power development may furnish sufficient market to promote some local agriculture along the Hudson Bay Railway. A clay belt estimated to contain over 6,000,000 acres crosses the railway about 130 miles northeast of The Pas.[27] Experiments made by the Dominion Department of Agriculture show that potatoes and vegetables can be grown successfully throughout this area and that, under favourable circumstances, wheat is a possible crop.[28] This clay belt is rendered more important by its closeness to the northern Manitoba mineral zone extending between the Nelson and Churchill Rivers.

Other fringe areas less remote from the older settlements but more than ten miles from a railway (see Fig. 40) wait expectantly for railway services. Apart from the influence of the current depression, many of them must wait a long time for the construction of railways. Costs of construction are higher than on

[25] Information by correspondence.

[26] Nelson, *op. cit.*, p. 248, footnote.

[27] F. H. Kitto, *The Hudson Bay Region* (Ottawa: Natural Resources Intelligence Service, Department of the Interior, 1929), pp. 15-16.

[28] *Ibid.*

the prairie, and the density of traffic is bound to be low. Governments may expect to be subject to pressure to subsidize, in one way or another, transportation facilities, whether railways or highways. Settlement, unless carefully controlled, is likely to become subsidized settlement in these areas.

In the colonization of the northern fringe limitations of soil and costs of transportation are likely to be more significant than direct climatic influences. The climatic difficulties can be more easily overcome by modified farm practice and proper selection of crops, but the exploitation of inferior soils remote from markets presents much greater difficulties and much greater probability of mistakes. Nowhere can so good a case be made for economic planning. In those areas where agriculture will be a subordinate industry the costs of unplanned development are painfully high. Even though mining is likely to be more important than lumbering in the forest regions of these provinces, the following comment on problems of settlement in the forest belt of European Russia contains important suggestions.

Therefore, colonizing this northern part of European Russia involves both the hunting-industrial and the rural occupation of the land, and that determines the specific forms in which occupation must take place. Namely, in the centre of forest areas in which lumbering operations are going on it is intended, first of all, to organize labour settlements, the male population of which will insure the presence of a permanent, all-year-round labour supply for lumbering in this particular district, the families of the workers concentrating their efforts in farming on good land specially designated for each such settlement. The products of the farms, in the form of different vegetables, butter, meat, and milk, will be consumed by the whole population of the lumber centre. In addition to such labour settlements, it is intended to establish different wood-technical and other mills. But because the lumber industry as well as every other industry cannot be satisfied merely by permanent labour contracted for in advance, therefore, to insure an adequate supply of seasonal labour, it is intended, in addition to the labour settlements, to establish collective peasant households, mostly practising cattle breeding, and to organize them in such a way that the occupants of these farms will have sufficient time to help in the lumber industry when the need is greatest. With periodical reinforcements for this purpose from the workmen's artels, these collective households will devote themselves to farming on a much larger scale than the population of the labour settlements, and by their considerably larger production will guarantee that there are enough supplies for local consumption. State farms (*sovkhoz*) for the breeding of cattle and growing of forage, established when possible near the lumbering centres, will pursue the same end. To the local industry they will be tied not only by the supplying of foodstuffs and forage but also by the exchange of workmen. In the end all the newest colonization in the North

will be based on the maximum rationalized balance of labour between certain regions, and on their self-sufficiency in everything except food grains.[29]

The development of the potential agricultural lands of the northern fringe calls for the greatest forethought and care. Policies based on insufficient knowledge are likely to lead to heavy financial and human costs. The province of Alberta has since 1929 pushed forward vigorously reconnaissance soil surveys which have already covered a large part of the northern districts (see Fig. 159). Work of this type should be extended in Saskatchewan as far north as the edge of the Precambrian Shield,[30] while in Manitoba it should include also the clay belt of northern Manitoba.[31] Surveys of this type must be made as cheaply as possible and must take into account other industries than agriculture. As already pointed out agriculture cannot stand alone in many of the districts where reasonably good soil is available.

The location of railways and highways should be determined on the facts disclosed by such surveys of the physical factors of settlement. It is better that fertile land should be left as grazing or forest land than that inordinate sums of money should be spent in making it accessible.

Where adequate land-classification surveys have been undertaken, governments may well assume more direct control of land utilization than has hitherto been practised. Unsuitable land must be withheld from settlement, and land restricted to the use for which it is adapted. As an aid toward this the adoption of the "use-lease" system was recommended in Saskatchewan.[32] The substitution of long-term leases for outright purchase relieves the settler of the original capital outlay, and gives to the government a more direct control over the use of the land.

Settlement policy will have to be adapted to the physical and economic conditions pertaining to particular localities. Land otherwise suitable may reasonably be closed to settlement unless satisfactory transportation is available. The conditions of acquisition should make it possible for the settler to acquire sufficient land to carry on economically the system of farming for which

[29] V. P. Voshchinin, "The Bases of Colonization in North European Russia", *Pioneer Settlement*, p. 238.

[30] See recommendation in Report of the Saskatchewan Royal Commission on Immigration and Settlement, 1930 (Regina: King's Printer, 1930), p. 15.

[31] Some work of this type was undertaken in connection with the Unused Lands Survey in Manitoba. See R. W. Murchie and H. C Grant, *Unused Lands of Manitoba* (Winnipeg: Department of Agriculture and Immigration, 1926), p. 126.

[32] Report of Saskatchewan Royal Commission on Immigration and Settlement, 1930, pp. 30-32.

the locality is suited because of its climate, soil, and nearness to markets.[33] Districts where there is not sufficient good land to permit the maintenance of the necessary social and economic services should not be opened to settlement.[34]

The problems of the "internal fringe" of settlement in the semi-arid belt have already been discussed. Soil surveys and irrigation surveys have disclosed the facts of this fringe more fully than those of the wooded fringe have been disclosed. The problems of settlement and of abandonment, however, will continue to be pressing as long as climatic variations and price variations bring recurring periods of good and bad years.

The Census of 1931 reports the population of the three Prairie Provinces as made up of 1,468,000 rural and 885,000 urban dwellers. Rural population increased from 1921 to 1931 by 17 per cent. and urban population by 26 per cent.[35] Land in farms in these provinces in 1931 totalled 110,000,000 acres, an increase of 23 per cent. since 1921.[36] Under favourable economic conditions land in farms may be expected to increase by 20,000,000 to 30,000,000 acres, depending on the proportion of woodland and grazing land included.[37] The extension of the agricultural area, the substitution of "mixed farming" for grain farming, and the high rate of natural increase among the non-Anglo-Saxon population[38] are factors favourable to an increase in rural population. The extension of mechanization and the increasing size of farms throughout almost the whole region are factors limiting such an increase. As markets for the products of mixed farming are not likely to be extended rapidly, as the area of suitable land open to settlement is not large, and as the size of farms on the Canadian plains is still considerably less than that in corresponding parts of the plains of the United States, it is likely that further increases in the rural population of the Prairie Provinces will be small, and that in the near future decline may succeed increase.

During the five years 1927–31 the average annual production of wheat in Western Canada was 392,424,000 bushels. The largest

[33] In certain areas economical utilization of land requires the combination of comparatively large areas of rough pasture land with smaller areas of arable land. See Murchie and Grant, *op. cit.*, p. 123

[34] *Ibid.*, p. 128.

[35] *Canada Year Book, 1932*, p 101.

[36] *Ibid*, p. 1066.

[37] See Appendix, p. 234.

[38] *Origin, Birthplace, Nationality, and Language of the Canadian People. A Census Study Based on the Census of 1931 and Supplementary Data*, prepared under the direction of W. B Hurd (Ottawa Dominion Bureau of Statistics, 1929), p. 34.

crop, that of 1928, was 544,598,000 bushels. D. A. MacGibbon has estimated that the wheat production of Western Canada may reach a maximum figure of 670,000,000 to 700,000,000 bushels.[39] This estimate is reached by adding to the acreage occupied the estimated acreage suitable for occupation, and applying to this area the relative production of wheat in 1928, the year in which the largest crop was harvested. MacGibbon estimated that in Saskatchewan and Alberta there were 19,000,000 acres unoccupied land suitable for settlement. Already, however, while his paper was being printed, there was recorded in the Census of 1931 an increase of 20,000,000 acres in the land occupied. It is estimated in the appendix of this volume that there remains an approximately equal amount suitable for settlement. Assuming a future occupied farm area of 130,000,000 acres and assuming a wheat acreage proportionate to, and a yield equal to that of 1928, a total maximum production of wheat of 704,000,000 bushels might be expected. Under peculiarly favourable economic circumstances this production might be largely exceeded. High prices for wheat would promote the substitution of wheat for other field crops in the Park and Forest Belts and would undoubtedly bring into extensive use chemical fertilizers which have proved efficacious in experiment but whose use was rendered uneconomical by the collapse of wheat prices in 1929–30.[40] The theoretical maximum of wheat production might therefore exceed the figure of 800,000,000 bushels set by Dr. Charles Saunders in 1904.[41] There is only a very small chance that such a theoretical maximum will ever be reached. There is little likelihood that the world market for wheat will expand sufficiently, or that Canada's competitors will curtail their exports sufficiently, to produce the highly favourable economic situation necessary to induce such a result. It is, indeed, unlikely that the figure of 700,000,000 bushels will be reached. The land which has been added to the occupied area since 1926 and that which will be added in the future is not land with special adaptation to wheat growing. The percentage of such land sown to wheat is much less than on the Prairie Plains, and the quality of wheat produced is inferior. Probably the Park Belt and the Forest Belt will be gradually converted to types

[39] D. A. MacGibbon, "The Future of the Canadian Export Trade in Wheat", *Contributions to Canadian Economics* (Toronto University of Toronto Press, 1932), V, p. 28.

[40] On fertilizer experiments see F. A Wyatt and J. D. Newton, *Wooded Soils and Their Management* (Edmonton: University of Alberta, College of Agriculture, Bulletin No 21, 1932).

[41] See p. 42.

of farming in which wheat growing is less important than it is at present. Forecasting rests on many arbitrary assumptions, but the most probable outlook for the Prairie Provinces, assuming a return to conditions approximating to those which we have become accustomed to call "normal," is for a further increase in the area of land in farms, say 15 to 25 per cent., a less than proportionate increase in the production of wheat, and an increase in rural population which may soon be converted into a decline.

Economic conditions as they exist in the spring of 1933 suggest forcibly the possibility that the agricultural region of the Canadian plains may face a continued period of low prices and restricted markets. In the face of high world stocks of wheat the curtailment of production may be forced on the exporting countries. The curtailment of production in particular areas, disregarding artificial schemes of curtailment, will be forced not only by a low price for wheat but by relatively higher prices for products which compete with wheat for the use of the land. It follows that the production of wheat under such circumstances would decline in those areas which have alternative uses for land but would not decline in the areas which have no alternative uses or have only much inferior ones. If the Prairie Provinces, in common with other wheat export regions, are under pressure to reduce wheat production, it can be predicted that reductions will come in the Forest and Park Belts, where the comparative advantage of wheat has not been great, and to a less extent in the centre of the semi-arid belt, where the uses of land for grazing or for growing characteristic irrigation crops become more profitable. The greater part of the Prairie Plains, however—that part which now practises a high degree of specialization in wheat (Fig. 102)—may be expected to maintain its production because of the absence of alternatives. That area will be the last stronghold of wheat in the Prairie Provinces to be forsaken.

APPENDIX ON SOILS[1]

Land Classification

The surveying and classifying of the agricultural land resources of Western Canada have been undertaken by several authorities. In the first instance, much information has been gathered by the Dominion land surveyors who, since 1873, have subdivided the various areas prior to settlement.[2] Such information was extremely uneven in quality and was rarely expressed in quantities. It provided little basis for an accurate estimate of the agricultural possibilities of districts. For the northern districts, this information has been published in summarized descriptions printed on the maps showing disposition of public lands.[3] In general, it provides no more than highly generalized descriptions of the country traversed by the surveyors.

The Geological Survey of Canada has provided much incidental information in its annual reports and other publications. Though only a few areal surveys have been concerned specifically with superficial geology, yet the other reports on the areas of Western Canada contain valuable information on superficial geology and the general character of soils. A map of the surface geology of southern Manitoba has been published[4] and a similar one for Saskatchewan is in preparation. Two soil maps have been published by the Geological Survey, one of the southern end of Lake Winnipegosis, and the other of the extreme southeastern corner of Manitoba[5] (Fig. 159).

Following the World War, the Topographical Survey of Canada undertook, in preparation for plans for settling demobilized soldiers on the land, a series of land-classification surveys along the northern fringe of settlement in Western Canada In all, seventeen areas were surveyed and mapped (Fig. 159). For most of the areas two maps were issued, one showing by quarter sections the classification of the land for purposes of settlement, and the other showing the main soil types. For the remaining areas only general land classification maps, based mainly on vegetation and topography, were published.

Soil surveys, ranging from the general land-classification type to detailed soil surveys, have been made by the Colleges of Agriculture connected with the provincial universities. In no province has the whole area been covered even by reconnaissance surveys, but several surveys have been carried out in each

[1] Adapted from a memorandum prepared by Dr. J. D. Newton, Department of Soils, University of Alberta.

[2] *Descriptions of Townships of the Northwest Territories* (Ottawa Department of the Interior, 1886).

Extracts from Reports on Townships, and *Abstracts from Reports on Townships* (Ottawa: Topographical Survey of Canada, issued at irregular intervals since 1900).

Description of the Surveyed Townships in the Peace River District, 3rd edition (Ottawa: Topographical Survey of Canada, 1916).

[3] Maps showing Disposition of Public Lands (scale of printed maps, 12½ miles to the inch): Saskatchewan, 19th edition, 1928; Northern Alberta, 14th edition, 1928, Manitoba (manuscript map), 1928 (Ottawa Natural Resources Intelligence Service, Department of the Interior).

[4] Winnipeg Sheet, Manitoba, Map 254A (Surface Deposits), scale 8 miles to the inch (Ottawa: Department of Mines, Geological Survey, 1931).

[5] W. A. Johnston, *Winnipegosis and Upper Whitemouth River Areas, Manitoba: Pleistocene and Recent Deposits* (Ottawa. Department of Mines, Geological Survey, Memoir 128, 1921), with Maps 1771 and 1802, each on the scale of 3 miles to the inch.

of the soil belts (Fig. 159). In Manitoba, provincial soil surveys have been confined to the Red River Valley, except for special investigations undertaken for the Unused Land Survey of 1926.[6] In Saskatchewan, surveys have been well distributed over the settled areas. In Alberta, extensive reconnaissance surveys have been made of the unsettled lands of the province.[7]

The areas in the Prairie Provinces which are still open to settlement lie almost wholly in the wooded soil belt and in the transition park and wooded soil belt (Fig. 160). In the main, the published reports of soil surveys have been confined to the settled areas. In the following pages an attempt is made to summarize the available information concerning agricultural land resources on the northern fringe. The information is derived from the published and unpublished

[6] R. W. Murchie and H C Grant, *Unused Lands of Manitoba* (Winnipeg Department of Agriculture and Immigration, 1926).

[7] The following is a list of the Provincial Soil Surveys so far published:

ALBERTA

F. A. Wyatt and J D Newton, *Soil Survey of Macleod Sheet* (Edmonton University of Alberta, College of Agriculture Bulletin 11, 1925)

F. A. Wyatt and J. D Newton, *Soil Survey of Medicine Hat Sheet* (Edmonton University of Alberta, College of Agriculture Bulletin 14, 1926).

F. A. Wyatt and J D. Newton, *Soil Survey of Sounding Creek Sheet* (Edmonton University of Alberta, College of Agriculture Bulletin 16, 1927)

F. A. Wyatt and J. D Newton and T. H. Mather, *Soil Survey of St Anne Sheet* (Edmonton University of Alberta, College of Agriculture Bulletin 20, 1930).

F. A. Wyatt and O R Younge, *Preliminary Soil Survey Adjacent to the Peace River, Alberta, West of Dunvegan* (Edmonton. University of Alberta, Research Council of Alberta, Report No 23, 1930).

SASKATCHEWAN

Roy Hansen, A. H. Joel, and A. M. Wilson, *Soil Survey of Baildon Municipality No. 131, Hillsborough Municipality No. 132, Moose Jaw Municipality No. 161, and Caron Municipality No. 162* (Saskatoon. University of Saskatchewan, College of Agriculture Soil Survey Report No. 1, 1923)

Roy Hansen, A. H. Joel, and A. M. Wilson, *Soil Survey of Swift Current Municipality No 137, Webb Municipality No. 138, Saskatchewan Landing Municipality No. 167, and Riverside Municipality No. 168* (Saskatoon University of Saskatchewan, College of Agriculture Soil Survey Report No. 2, 1923)

Roy Hansen, A. H. Joel, and A. M. Wilson, *Soil Survey of Local Improvement Districts Nos. 21, 22, and 52 and Reno Municipality No. 51* (Saskatoon: University of Saskatchewan, College of Agriculture Soil Survey Report No. 3, 1925).

Roy Hansen, A. H. Joel, and A. M. Wilson, *Soil Survey of Weyburn Municipality No. 67, Brokenshell Municipality No. 68, Wellington Municipality No. 97, and Scott Municipality No 98* (Saskatoon University of Saskatchewan, College of Agriculture Soil Survey Report No 4, 1926)

A. H. Joel, J. Mitchell, and F. H. Edmunds, *Soil Survey of the Bienfait-Oxbow Area, including the Municipalities of Enniskillen No 3, Coal Fields No. 4, Moose Creek No 33 and Browning No 34* (Saskatoon. University of Saskatchewan, College of Agriculture Soil Survey Report No. 5, 1926)

A. H. Joel, Roy Hansen, and A. M. Wilson, *Soil Survey of The Rosetown Area, including the Municipalities of St Andrews No. 287, Pleasant Valley No. 288, Marriott No. 317, Mountain View No. 318* (Saskatoon· University of Saskatchewan, College of Agriculture Soil Survey Report No. 6, 1927).

A. H. Joel, F. H. Edmunds, and J. Mitchell, *Soil Survey of the Birch Hills-Melfort Area including the Municipalities of Carrot River No. 429, Invergordon No. 430, Weldon No. 459, Birch Hills No. 460* (Saskatoon: University of Saskatchewan, College of Agriculture Soil Survey Report No 7, 1928).

A. H. Joel, F. H. Edmunds, and H W. E. Larson, *Soil Survey of the Leader-Maple Creek Area including the Municipalities Nos 109, 110, 111, 139, 141, 142, 169, 171, 172, 229, 230, 231, 232, and Local Improvement Districts Nos. 112, 140, 170* (Saskatoon: University of Saskatchewan, College of Agriculture Soil Survey Report No. 8, 1929).

A. H. Joel, J. Mitchell, F H. Edmunds, and H. W. Larson, *Soil Survey of Southwestern Saskatchewan—From the Third Meridian on the East to the Alberta Boundary on the West, and from the Top of Township 16 on the North to the International Boundary on the South* (Saskatoon: University of Saskatchewan, College of Agriculture Soil Survey Report No. 9, 1931).

reports of soil, land-classification, and geological surveys, from surveyor's notes, from correspondence and interviews with those familiar with particular areas, and from personal inspection.

Reconnaissance Soil Survey of Northern Alberta Areas

Fort Vermilion Area

This survey includes an area on the east side of the Peace River, extending from the town of Peace River to Fort Vermilion, and on the north side of the Peace River, extending from Keg River to Fort Vermilion, and north and west to Hay River (areas 5 and 6 on Fig. 159).

On the north side of the Peace River, from Keg River to Fort Vermilion and northwest to Hay River, the topography is level to undulating at the lower levels and somewhat more rugged at the higher elevations. Huge muskegs mantle the greater portion of the hilly regions. The country east of the Peace River is for the most part gently rolling.

Extensive areas of muskeg and swamp are found throughout most of the area between the town of Peace River and Fort Vermilion on the east side of the river, the percentage being as high as seventy-five in certain parts.

The better soils are found as strips from one to four miles wide along each side of the Peace and Boyer Rivers, near Fort Vermilion.

Table I—Soils of Fort Vermilion Area

	Acres	Per Cent.
First- and second-class black park soils (black transition)	36,960	0.8
First-class grey timber soil (grey transition)	440,970	9.4
Second-class grey timber soil	2,105,550	45.0
Third-class grey timber soil	1,413,920	30 2
Eroded	49,070	1 0
Muskegs (muskegs of third-class grey timber soil not incl.)	554,940	11.9
Lakes	13,140	0 3
Rivers	62,670	1.4
Total	4,677,220	100 0

The second-class grey timber soils form the largest class, followed by the third-class grey timber soils.

The soils of the whole area consist, to a very great extent, of the heavier textured classes and vary from heavy loam to clay. In such areas the subsoil is almost invariably heavy. The very light soils are associated, almost invariably, with jack pine ridges and muskegs and occur in the third-class grey timber soils areas.

The soils show the effect of a rather dry cool climate. Leaching has not been excessive and the lime layer is relatively close to the surface.

Practically the whole region has been heavily wooded, but it has been largely burned over. In general the second-class grey timber soils require medium to heavy clearing, and the first-class timber soils require less heavy clearing.

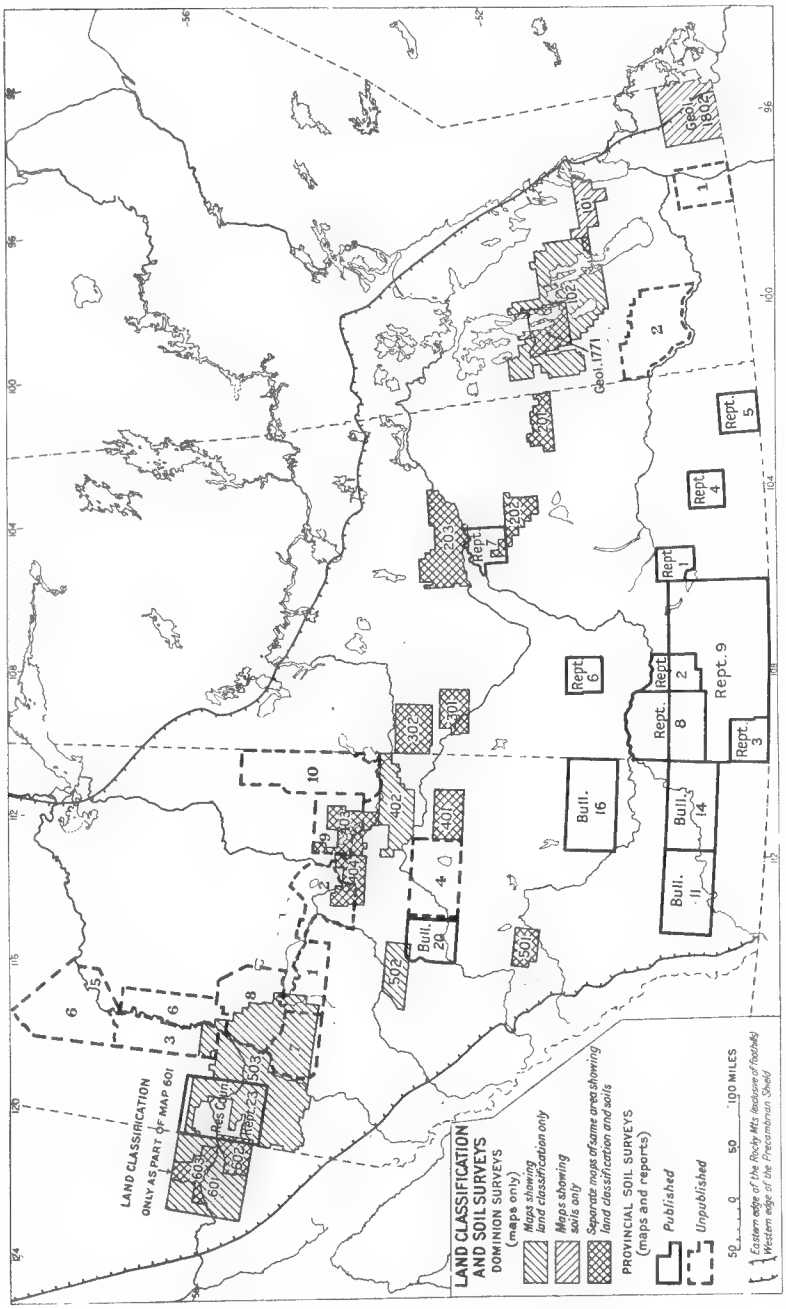


FIG. 159—Index map to soil surveys of the Prairie Provinces as at June, 1933. Surveys numbered 101, 102, 201, etc., to 603, were published by the Topographical Survey of Canada (outlines here shown are based on an index map issued by that office), those designated Rept. 1, Bull. 11, etc., were published by the College of Agriculture of the Universities of Saskatchewan andAlberta respectively (see list in footnote 7), those in Manitoba marked Geol. 1771 and Geol. 1802 were published by the Geological Survey of Canada (see footnote 5). The outlines of the unpublished surveys in Manitoba and Alberta, marked 1, 2, 3, etc., are based on a manuscript map by Dr. J. D. Newton.

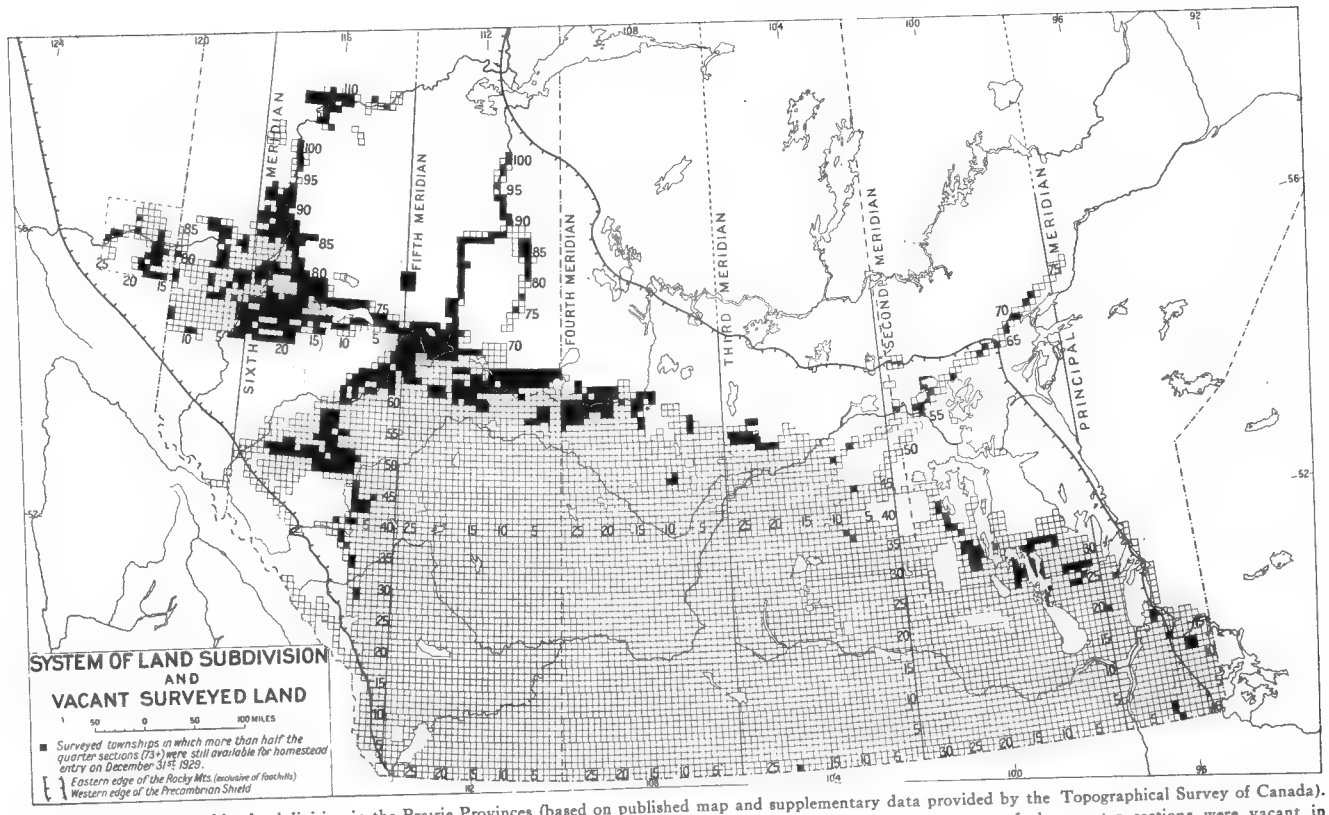


FIG. 160—System of land subdivision in the Prairie Provinces (based on published map and supplementary data provided by the Topographical Survey of Canada). The surveyed area is outlined as of June 30, 1933. The solid black areas represent townships in which more than 50 per cent. of the quarter sections were vacant in December, 1929. This information was obtained from the published map of the National Resources Intelligence Service, scale 35 miles to 1 inch, 10th edition, 1929, showing in red figures the number of vacant quarter sections in each surveyed township at that date. The designation of the meridians and the numbering of the townships (vertical series) and ranges (horizontal series) on this map will enable the reader to identify localities defined in these terms in the text.

It is thought that, in the vicinity of Fort Vermilion, no great difficulty would be encountered in obtaining water by sinking wells.

Owing to the level topography of the Hay and Boyer river systems drainage is inadequate, and as a consequence much of the area is swamp and shallow muskeg. The swamp lands, if reclaimed, should form fertile soils.

The greater part of the second-class grey timber soil would probably respond to fertilizer treatments. Such treatments, however, are out of the question until the areas become more thickly settled and are adequately supplied with transportation facilities. In the meantime, the management of these areas should include the growing of clovers or legumes and the use of all available farm manures.

TABLE II—SOILS OF WHITEMUD AND BATTLE RIVER AREAS
(TOWNSHIPS 85 TO 98, INCLUSIVE, BETWEEN THE SIXTH MERIDIAN AND THE PEACE RIVER)

	Acres	Per. Cent
First-class black park soil (black transition)	11,200	0 7
Second-class black park soil (black transition)	62,700	3 6
First-class grey timber soil (grey transition)	82,900	4 8
Second-class grey timber soil	181,800	10 5
Third-class grey timber soil	1,266,100	73 3
Muskegs and swamps	60,800	3.5
Eroded (along river)	62,600	3.6
Total	1,728,100	100.0
SOILS OF KEG RIVER AREA		
First-class black park soil (black transition)	10,900	5 9
First- and second-class grey timber soil	52,800	28 6
Second-class grey timber soil	23,000	12 5
Third-class grey timber soil	97,600	53.0
Total	184,300	100 0

With the present transportation facilities the area should not be regarded as a potential wheat-producing country. A system of mixed farming should be adopted in which all raw products are fed locally to livestock and only the more concentrated livestock products shipped up the river.

Area from Grimshaw to Keg River, Between the Sixth Meridian and Peace River

The area from Grimshaw to Keg River, between the sixth meridian and Peace River, is found chiefly in townships 85 to 104, ranges 21 to 25, west of the fifth meridian (area 3 on Fig. 159). The southern boundary is about ten miles north of the present railroad.

The districts suitable for agricultural development have the following elevations: Whitemud district, 1,800–2,000 feet; Battle River district, 1,600 feet; Keg River district, 1,200–1,400 feet. Around these plains the land rises into hills from 400 to 1,000 feet higher.

In certain areas swamps are abundant. The land adjacent to the Peace River has the poorest drainage of the area surveyed. The areas of good soil are, for the most part, very well drained, but muskegs are numerous on most of the poorer soil areas. On some of the upland plateaus, such as the Clear Hills, it is estimated that from 30 to 70 per cent. of the total area consists of muskegs. At some future time some of the muskeg areas will be productive, especially where the muskeg is swampy in nature or relatively shallow.

The areas of good and poor soil have had distinctly different geological histories. Practically all the third-class timber soil has developed on moraines. The areas of good soil, on the other hand, have developed on lake- or river-deposited material and are level or rolling in nature. The soils consist, to a very large extent, of the heavier textured classes, varying from heavy loam to clay, and the subsoil is almost universally heavy. The percentage of light sandy soils is extremely small.

The surveyed area is rather well supplied with streams, and there are also numerous lakes in certain parts It is thought that the northern part of the Battle River district will offer some difficulty in connection with obtaining adequate water supplies, and certain local districts, no doubt, will present rather serious water difficulties.

The park soils have been partially degraded by timber growth. The black park and first-class grey timber soils are desirable soils for cultivation, the second-class are marginal under our present farming practices, whereas the third-class grey timber soils are sub-marginal.

Along some of the valleys of the Peace River tributaries there is considerable land which would be fit for grazing. There is little grazing land along the Peace River in the northern part of the surveyed area.

Area Adjacent to Peace River, West of Dunvegan

This area is located between Dunvegan on the east and the Alberta-British Columbia boundary on the west, and it extends from the Clear Hills on the north to the Saddle Hills on the south. The area is located in townships 74 to 88 inclusive, and ranges 4 to 13 inclusive, west of the sixth meridian (area designated "Res. Coun. Rept. 25" on Fig. 159).[8]

Here the Peace River and its tributaries have deeply eroded channels. The tributary channels, except for the larger ones, rapidly decrease in depth and width with increase in distance from the banks of the Peace River, until at a distance of four to six miles they merge into the level plain.

The general topography of the country is undulating to rolling, in so far as the plain and plateau parts are concerned. The topography of the Clear Hills area consists of ridges and low hills separated by wet muskegs and swamps.

The Clear Hills and Saddle Hills contain soils which have been formed, very largely, from the weathering of the underlying parent materials, whereas the areas of good soil have developed on lake- or river-deposited material. The stony soils are usually associated with the rougher hilly or morainal topography.

[8] Of the provincial soil surveys along the northern fringe of settlement this is the only one that has been published (see footnote 7 under Alberta) It is accompanied by a soil map which is here reproduced as Fig. 133 on p. 161.

The black park soils are the most desirable. In general they are not true black park soils, but have been partially degraded by the timber growth which has occupied the soil.

The black park soils and the first-class grey timber soils (grey-black transition) are found on the table land and river valley areas where topography and drainage are desirable, whereas the poorer phases of the timber soil as a rule occupy the areas of rough topography. In certain parts there are considerable areas too flat for good drainage which consequently contain much muskeg and willow swamp.

It has been estimated that good soils cover a little more than 40 per cent. of the total area, and it is thought that the second-class grey timber soil, covering an additional 30 per cent., could be used for farms. These second-class soils are regarded as marginal areas.

In many parts of the area the surface water is entirely inadequate, and this is especially the case on the south side of the Peace River.

TABLE III—SOILS OF AREA ADJACENT TO PEACE RIVER, WEST OF DUNVEGAN*

	ACRES	PER CENT
Second-class black park soil (black transition)	579,570	22.2
First-class grey timber soil (grey transition)	548,295	21 0
Second-class grey timber soil	762,655	29 2
Third-class grey timber soil	481,055	18 4
Rough lands	192,995	7 4
Muskegs	33,120	1 2
River	15,305	0 6
Lake	1,205	0 05
Total	2,614,200	100 00

* Research Council of Alberta Report No. 23, p 20.

The forest covering, apart from the hills, consists mostly of poplar and willow, with scattered areas of spruce and pine. The cost of clearing varies from heavy to very light, but most of it will fall in the medium to heavy class. In general, the better soils require less clearing than the light.

It is doubtful if there exists any other single area of similar size in the north country, at the present time, where the percentage of unoccupied desirable soil is as great as that found in this area.

The Clear Hills and Saddle Hills should be set aside as forest reserves.

Area Between Aggie and Bezanson

This area lies principally between the forks of the Big and Little Smoky Rivers, north of township 68, but includes also an area east of the Little Smoky (area 7 on Fig. 159). The area is located mainly in townships 69 to 75 inclusive, and ranges 18 to 26 inclusive, west of the fifth meridian, and ranges 1 and 2, west of the sixth meridian.

The topography is generally level or undulating, but there are three major elevations of about 300 to 500 feet above the level of the plateau.

The soils generally consist of the heavier textured classes, varying from heavy loam to clay, with heavy subsoils.

There are comparatively few muskeg areas and these are shallow. In addition to the muskegs there are some poorly drained willow swamp areas.

Table IV shows that the second-class grey timber soil forms the largest class, by far, and this class is regarded as marginal farm land. The better farm lands make up about 9 per cent. of the area.

A large proportion of the area is or has been heavily wooded, and some very good stands of merchantable timber were observed.

Lack of water, in certain parts, will be an important problem, but on the whole there is less difficulty in obtaining adequate water supplies than is the case of the area west of Dunvegan.

The poorer soils should be regarded chiefly as mixed farming areas, rather than as potential wheat lands, except possibly in the areas where the water supply is inadequate for livestock.

TABLE IV—SOILS OF AREA BETWEEN AGGIE AND BEZANSON

	Acres	Per Cent.
Second-class black park soil (black transition)	18,880	1 1
First-class grey timber soil (grey transition)	139,520	8 0
Second-class grey timber soil	1,284,320	73.1
Third-class grey timber soil	127,840	7 3
Muskegs	40,960	2 3
Eroded	113,920	6 5
Lakes	30,720	1.7
Total	1,756,160	100.0

The eroded river lands in general furnish the best pasture to be found in the surveyed area.

Area Between Peace River and Grouard

This area lies between Peace River Town and Grouard (area 8 on Fig. 159). It is bordered on the west by the Smoky and Little Smoky Rivers, and its southern boundary is the line between townships 75 to 76, just north of Lesser Slave Lake.

The topography of the western portion is flat to gently rolling, as a rule, whereas the northern and eastern parts are gently to heavily rolling

Nearly all the area has been heavily wooded, but most of it has been burned over.

The third-class grey timber soils covering half the area are not considered suitable for general settlement. The second-class, occupying 16 per cent., might be settled, whereas the first-class grey timber soil and the black park soil (13 per cent. together) are very good farm lands

The conditions affecting water supply throughout the area are so varied that no general statement can be made. In some districts no difficulty is experienced while in others it is practically impossible for the individual farmer to obtain a supply sufficient for his requirements.

TABLE V—SOILS OF AREA BETWEEN PEACE RIVER AND GROUARD

	ACRES	PER CENT.
Second-class black park soil (black transition)	66,680	2.6
First-class grey timber soil (grey transition)	264,080	10.3
Second-class grey timber soil	420,380	16 4
Third-class grey timber soil	1,305,860	51.1
Muskegs	445,000	17.4
Lakes	55,000	2.2
Total	2,557,000	100 0

Area North and West of Athabaska

This area can be divided into two parts, one lying north of the Lesser Slave and Athabaska Rivers east of Lesser Slave Lake, and the other south of the Athabaska River between the towns of Smith and Athabaska (area 2 on Fig. 159). Practically the entire area lies between townships 66 and 73, inclusive.

There are no high hills in the area, and a large proportion of it is nearly level or gently rolling. The level nature of the country is partially responsible for the presence of large areas of swamp and muskeg. The whole area has been glaciated and there are many moraines, all of which extend in a northwest-southeast direction. Some marl deposits were observed.

No large areas of black park soil occur in this district, and grey timber soils predominate. Muskegs cover about one-fifth of the area.

Over the greater part of the territory the surface soil is intermediate in texture, with a heavy subsoil. However, there are areas of lighter textured soils, and some sand dunes.

The most extensive native hay meadows are found near Lesser Slave Lake, where large quantities of hay are cut every year. Flooding sometimes reduces the area that can be cut.

Less than 4 per cent. of the area is what might be termed really good soil. An additional 6 per cent. is satisfactory for settlement under present farming conditions. Some of the shallow muskegs and certain swamps will, no doubt, furnish fertile lands when drained and reclaimed.

The area is, in general, rather abundantly supplied with surface water.

TABLE VI—SOILS OF THE AREA NORTH AND WEST OF ATHABASKA

	ACRES	PER CENT.
First-class grey timber soil (grey transition)	50,920	3 3
Second-class grey timber soil	88,320	5 7
Third-class grey timber soil	1,071,320	70 7
Muskegs	310,080	20 3
Total	1,520,640	100 0

Lac La Biche Area

This area lies between the Athabaska River on the west and the Sand River on the east, from townships 65 to 72, inclusive (area 9 on Fig. 159). In other words, it is the territory adjacent to Lac La Biche.

The land is gently rolling to hilly, the rougher country being southeast of Heart Lake. Glacial boulders and morainal dumps occur throughout the area. Some deposits of marl were observed. Lac La Biche is the largest of the many lakes that are found in this district.

No areas of black park soil occur in this district. The soils (apart from muskegs) all belong to the grey timber class, except for small areas of delta and river bottom land which have been built up by accumulation of organic material and river deposits. About half of the third-class grey timber soil is light and sandy, and many sand dunes occur in the sandy country north of Lac La Biche. Muskegs and swamps occur in all parts of the area, and occupy approximately one-fourth of the total surface.

TABLE VII—SOILS OF THE LAC LA BICHE AREA

	Acres	Per Cent.
First-class grey timber soil (grey transition)	107,136	6 3
Second-class grey timber soil	145,792	8 6
Third-class grey timber soil	854,178	50 0
Muskegs	440,030	25 8
Lakes	145,152	8.5
Eroded	12,672	0 8
Total	1,704,960	100 0

Very little grass is found in the mixed sand and muskeg areas, such land being of value only if it will produce commercial timber. Some of the shallow muskegs, and especially those adjacent to good land, may be reclaimed. Many low areas can be developed into hay meadows by drainage and clearing.

Wells are generally satisfactory and the numerous lakes and streams supply an abundance of good water for livestock.

Area Between Cold Lake and Cheecham

This area lies north of Cold Lake. It is bounded on the east by the Alberta-Saskatchewan boundary, on the west by ranges 6 or 7 west of the fourth meridian, and it extends north and south from township 63 to township 84 (area 10 on Fig. 159).

The general relief of the area is comparatively low. Deep channels and valleys are generally absent. Morainal material occurs at various intervals throughout the entire area.

The best soils are found along the Beaver River and in the vicinity of Cold Lake, at the southern end of the area.

Light sandy soils are found north of Wolf River and along the Sand River. The third-class grey timber soils are largely light sandy soils, badly leached and interspersed with muskeg and morainal material. In certain sections of the area it is estimated that muskegs cover 90 per cent. of the land.

TABLE VIII—SOILS OF THE AREA BETWEEN COLD LAKE AND CHEECHAM

	Acres	Per Cent.
First-class grey timber soil (grey transition)	72,480	2 1
Second-class grey timber soil	66,080	1 9
Third-class grey timber soil	1,170,080	33 9
Muskegs	1,848,320	53 6
Eroded	24,320	0 7
Lakes	268,320	7.8
Total	3,449,600	100 0

Only about 4 per cent. of the total area is considered suitable for early settlement. Much of the muskeg cannot be considered as potential agricultural land, since it occurs in conjunction with extremely sandy upland soils.

The area has been swept by repeated fires.

The greater part of the entire area, especially north of township 67, has no roads, and only a few very poor pack trails.

Other Alberta Areas

Soil surveys have barely touched a great area in Alberta east of Peace River and north of Lesser Slave, Calling, La Biche, and Cold Lakes. Minor areas of good soil occur within this great area, close to its southern and western fringe, as shown by the reconnaissance soil surveys of the Fort Vermilion, Peace River, Grouard, and Lac La Biche areas. However, only about 4 per cent. of the surveyed area between Cold Lake and Cheecham was found suitable for early settlement. This indicates that the main body of the great area referred to contains a very small percentage of land fit for cultivation, and is therefore more suitable for forestry than for agricultural purposes.

Soil surveys have covered only a very small part of the large triangular area of grey timber soil shown on the map (Fig 24 on p. 23) between the Rocky Mountains and the main black park soil zone, and extending from a point about twenty miles west of Olds, in township 32 or 33 (about 51° 50′ N. and 114° 40′ W.) north to township 69 (55° N.). The indications are, however, that there is a much larger percentage of land suitable for cultivation in this area than in

TABLE IX—SOILS OF EASTERN HALF OF ST ANN SHEET

	Acres	Per Cent
First-class black park soil	40,300	3 3
First-class grey timber soil (grey transition)	524,200	42 2
Second-and third-class grey timber soil (mainly second-class)	493,800	39 7
Muskeg or peat	34,600	2 8
Eroded	43,200	3.5
Water	74,700	6 0
Indian Reserves	30,500	2 5
Total	1,241,300	100 0

the great area of northeastern Alberta previously referred to. With the information at hand it is not possible to estimate, with any degree of accuracy, the percentages of sub-marginal, marginal, and satisfactory farm land of this area.

However, the soil survey of the eastern half of the St. Ann sheet [9] is representative of one of the better parts of the area, as it lies close to the black soil zone and actually includes a small area of black soil. This survey extended from the fifth meridian west to include part of range 7, and north and south from township 49 to township 56, inclusive ("Bull. 20" area on Fig. 159). The percentages of the different classes of soil in the eastern half of the St. Ann sheet are shown in Table IX. Over 40 per cent. of the area is classified as first-class grey timber soil. This is undoubtedly much higher than the average percentage of first-class grey timber soil throughout the large area between the Rocky Mountains and the main black park soil belt south of township 69.

In the southern part of the area lying between the Rocky Mountains and the main black park soil belt, a soil survey of the Sylvan Lake district (area 501 on Fig. 159) was made by the Topographical Surveys Branch of the Department of the Interior. This survey showed that, as far west as Rocky Mountain House, the soils are rather similar to those of the St. Ann sheet. West or southwest of Rocky Mountain House, however, much muskeg was observed, and only a very small percentage of the land is cultivable.

Evidently the percentage of cultivable land close to the Rocky Mountains is very small, as, for example, west of Rocky Mountain House on the Canadian Pacific Railway branch line, and west of Edson on the Canadian National Railways main line. The percentage of cultivable land in the Swan Hills area, south of Lesser Slave Lake, is also very small.

The Peace River Block of British Columbia

The Peace River Block of British Columbia, though outside the political boundaries of Alberta, is an integral part of the Peace River Valley, and has been colonized from Alberta. It occupies an area of nearly 3,500,000 acres, mainly in townships 77 to 88 (inclusive) and ranges 14 to 25 (inclusive) west of the sixth meridian (see Fig. 121 on p. 151) The Alberta boundary lies at the eastern edge of the Block, and about half of the area lies on the north side of the Peace River and about half on the south side.

Although fairly level in places, the Peace River Block is for the most part an area of great rolling hills. It is generally fairly heavily wooded with poplar, spruce, and jack pine, but is open or park-like in places. There is considerable eroded land along the deep valleys of the tributaries of the Peace River and along the Peace River itself.

On account of the rolling character of much of the district the soils are frequently patchy. In places the deeper or blacker soils are found along or near the stream courses and the poorer grey timber soils on the hills. The better soils are also sometimes found on flat or sloping areas. Some very good alluvial black soil occurs as bench land along the Peace River.

[9] University of Alberta College of Agriculture Bulletin No. 20 (see above, footnote 7).

The better soils occur frequently in the open or semi-open parts of the district.[10] Here the surface layer of dark top soil is moderately thick (probably about six inches thick on the average). As a rule, the surface soil in the better areas is quite loamy, but the subsoil at a depth of a foot or so is usually a heavy clay.

The less fertile grey timber soils cover a large proportion of the district. As previously noted these soils are characterized by a thin, dark, organic matter layer at the surface and a leached grey soil layer just below the surface.

The 3,500,000 acres of land included in the Peace River Block have been classified according to vegetation by the Topographical Surveys Branch as follows:—

	Acres
Open and semi-open grassland	284,000
Light forest cover	331,000
Medium forest cover	646,000
Heavy forest cover, rough land, swamp, and muskeg	2,239,000
	3,500,000

North of the Peace River Block, along the Beatton River and its tributaries, there are undoubtedly other areas of good soils.

Satisfactory wells are uncommon in the Peace River Block because of the great depth of heavy subsoil in most places. Because of the rolling character of much of the district and the numerous stream courses it is usually possible for the farmers to build satisfactory dams or dug-outs in which to collect water for stock. The smaller streams flow only in wet weather. However, the subsoil is not clay everywhere, and springs occur in some places.

Where satisfactory water for stock is available the district is probably best adapted to livestock or mixed farming, as much of the land is more suitable for pasture and for legumes and other mixed farming crops than for wheat growing. Ranching is carried on to a limited extent in the district, and, where water for stock is available, this is a satisfactory method of utilizing some of the poorer grey timber soil areas. Certain parts of the district which are not suitable for mixed farming or ranching will probably always be kept as forest reserves.

Grande Prairie Area

The main area of good soil in the vicinity of Grande Prairie lies west of the Smoky River and north of the Wapiti River (area 5B in 55½° N. and 119° W. on Fig. 24). It extends from township 70 to township 75, and from range 2 to range 11, west of the sixth meridian.

This area has not been surveyed by Alberta provincial soil survey parties, but is covered by a land classification map of the Topographical Survey (part of area 503 on Fig. 159). It is estimated to contain about 650,000 acres of black

[10] See areas of open or semi-open lands shown on the land-classification map of the Peace River Block on the scale of 4 miles to the inch, prepared by the Topographical Survey, Department of Interior (area 601 on Fig. 159). Soil maps on this scale have been published by the Topographical Survey of two sections of the Block (areas 602 and 603 on Fig. 159). As on these the soils are classified by texture only, the land-classification map remains a useful guide to the distribution of soils as conditioned by climate and vegetation.

park soil (black-grey transition) and about 160,000 acres of first-class grey timber soil (grey-black transition).

The Grande Prairie area is a well-established farming district. Water can be obtained with less difficulty here than in the adjacent district to the north. The soils are generally heavy in texture and relatively fertile.

The Soils of Mid-Saskatchewan

The Transitional or Grey Timber Soil Zone

The transitional or grey timber soil zone covers a wide area north of the black park soil zone and extends for some distance down the east side of the province, east of the black soil zone. It is considered that the transitional or more desirable part of this zone lies south of a line drawn across the province from Cold Lake on the Alberta border (55½° N.) to the point where the Saskatchewan River enters Manitoba, just west of The Pas, as shown on the map (Fig. 24). The transitional or grey timber soil zone south of this line covers about 15,000,000 acres. Soil surveys have, so far, covered only a small part of this great area, and much of the land will, no doubt, be classed as marginal and sub-marginal, but it is believed that more than 10 per cent. of the area could be satisfactorily brought under cultivation.

It should be understood that the divisional line previously referred to, extending across the province from Cold Lake to The Pas, does not represent a definite boundary between different kinds of soil. Isolated areas of agricultural and hay meadow land occur north of this line. Broadly speaking, however, the land north of this line is considered more suitable for forest reserves than for agricultural purposes.

Typical grey timber soils of this and other similar areas are characterized by a light grey leached sub-surface layer under a shallow surface layer of dark-coloured forest leaf mould. When ploughed, the grey soil is turned up to the surface, and it frequently tends to bake when dry. The texture or physical condition of the soil is greatly improved by ploughing down clover or grass, and by applying barnyard manure.

Drainage varies greatly over the grey timber soil zone. Small lakes, marshes, and peat or muskeg areas are fairly numerous in many parts of this zone. Stony areas are common, also.

Only a small proportion of this zone is as yet under cultivation. Recently, there has been a considerable movement of settlers into the better parts of this zone, such as the Birch Bark Lake and Whitefox River districts (53½° N. between 105° and 104° W.). Good crops have been produced in the better districts.

The grey timber soil zone is not generally as well adapted to straight grain farming as the other soil zones. It is not, on the whole, as level or as suitable for large-scale machinery. Furthermore, the fertility of the grey soils is frequently rather poor, and many of these soils are slightly acid. It will frequently be necessary, therefore, to grow soil-enriching crops, such as clover and alfalfa, and apply lime or marl and other fertilizers, in order to produce good crop yields. Livestock is required to consume the forage crops grown,

and conditions are naturally favourable, therefore, to the development of mixed farming in the grey timber zone.

Birch Hills-Melfort Area[11]

The Birch Hills-Melfort surveyed area lies mainly between the Saskatchewan River on the north (in township 49) and township 43 (inclusive) on the south, and between ranges 19 to 24 (inclusive), west of the second meridian (area "Rept. 7" on Fig. 159). The area was divided for classification purposes into two main topographical units, which for convenience in description were designated the "Melfort Plain" and the "Birch Hills". The Melfort Plain belongs to the black soil zonal belt. The Birch Hills, covering the west-central and southern part of the area, are a westward continuation of the higher land culminating in the Pasquia Hills.

The Birch Hills may be considered as representative of a part of the grey timber soil zone of Saskatchewan, as it is evident from an examination of the soil, with its ashy grey colour, that the whole of the belt has been covered by a thick growth of trees for a long period of time.

Much of the soil of mid-Saskatchewan is of the same general nature as the Waitville soil types found in the Birch Hills area. These soils are known locally as "white clay" and are characterized principally by a light grey soil under a surface of dark-coloured forest leaf mould. Drainage varies greatly over these types. Marshes and small lakes are fairly numerous. Stony areas are common, also.

Certain inherent characteristics of the soil itself tend to lower its fertility, namely: low organic matter, acid reaction, and poor structure. The results of farming efforts have been less satisfactory than on most lands of the black park soil zone. Good crops have been produced, however, in favourable years.

The use of sweet clover, barnyard manure, and, in some cases, the use of lime will undoubtedly improve these lands. The chemical analysis of some samples indicated a lack of available phosphorus.

The general development of the area has been somewhat slower than development on most of the prairie and plains areas, and this is largely due, no doubt, to the necessity of clearing off the growth of trees and shrubs. On the other hand, there has been far less abandonment of land than in many of the drier plains areas.

The average yearly precipitation of the district is about 16 inches, and its seasonal distribution is generally favourable to crop production.

Water of good quality is usually obtainable from shallow wells in the rolling belts and sandy land, and for livestock, from streams, marshes, and lakes.

Livestock production has been relatively more important than on most of the prairie and plains areas. Natural conditions are well suited to mixed farming, and this will no doubt ultimately become the prevailing system of agriculture over this and similar areas.

Area North and East of Onion Lake

The district north and east of Onion Lake, of which the soils were mapped by the Topographical Survey, lies between townships 55 and 60 (inclusive),

[11]Information regarding this area was obtained from University of Saskatchewan Soil Survey Report No. 7; see above footnote 7.

and ranges 20 and 27 (inclusive), west of the third meridian (area 302 on Fig. 159). The Alberta border forms the western boundary of the district. The area lies wholly within the grey timber soil zone and covers about 1,000,000 acres.

The land has been classified as mainly sand and sandy loams best adapted to grazing or forestry. Less than one-tenth of the district has been classified as really suitable for cultivation.

Much of the land is rolling or hilly, and lakes and streams are numerous throughout the area. Stony ridges occur commonly in the sandy areas.

The tree growth consists mainly of poplar, spruce, tamarack, and jack pine. Spruce and tamarack trees grow commonly in the muskegs and jack pines on the sandy ridges.

Area North and East of Preeceville

The greater part of the district north and east of Preeceville soil-surveyed by the Topographical Survey lies within the grey timber soil zone. The Manitoba border forms the eastern boundary of the district, which lies just west of the town of Swan River, Manitoba, and just south of the Porcupine Forest Reserve (area 201 on Fig. 159). The surveyed area covers nearly 32 townships, or about 700,000 acres.

This area contains a much larger proportion of land suitable for cultivation than the area north and east of Onion Lake, previously discussed, which lies within the same soil zone.

The greater part of the area is classed as level to gently rolling clay loam, stony in places. The remainder of the area is classed mainly as level to gently rolling loam and sandy loam, also stony in places.

The Soils of South-Central Manitoba

The Grey Timber Soil Zone

The grey timber soil belt of Manitoba, characterized by high-lime peats, surrounds Lakes Manitoba and Winnipegosis (Fig. 24). Agriculturally the soils of this zone may be regarded as mainly marginal or sub-marginal.

The underlying rock formation of this zone consists of limestone. The soils are frequently stony, and the underlying limestone rocks come to the surface in places. High-lime peats or muskegs are common throughout the area, and there is much marsh land. The general relief of the area around and between the lakes is very small, and the numerous swamps are often difficult to drain. Water for stock is generally easily obtained.

Where used for agricultural purposes the land is probably best suited to mixed or dairy farming purposes. But, since the areas of good cultivable land are nearly always small, the farmer should have a fairly large acreage at his disposal in order to have considerable land for pasture, and perhaps marsh land upon which to cut marsh hay for feed, in order to make a satisfactory living.

The soils of the great area east of Lake Winnipeg have not been surveyed, but the area is known to be very rocky and to contain numerous lakes and muskegs The rocks of this territory are generally classified as Precambrian granites. The peats of the area are generally acid, in contrast to the high-lime

peats west of the lake. It is doubtful if there are any important areas of agricultural land in this territory, although restricted areas of good land adjoin the larger streams and lakes.

North of Lakes Winnipeg and Winnipegosis soil surveys have not been conducted, but apparently the land is mainly spruce-covered muskegs, and cultivable land is scarce. Just west of The Pas, along the Carrot River, there are large clay flats which might be cultivated, but this land is flooded in years of high water. Wild hay is cut on these flats. Along three hundred miles of the Hudson Bay Railway northeast of The Pas there are a few areas of cultivable grey timber soil. These areas are probably small, but their extent is not known. Southwest of The Pas, along the railway to Hudson Bay Junction and for some distance beyond, the land is mainly spruce-covered muskegs. Dolomitic limestone underlies much of the territory. The peat lands and soils are therefore not acid.

District Adjacent to Lakes Winnipegosis and Manitoba[12]

This area (102 on Fig. 159) lies on the east and north sides of Lake Manitoba, from The Narrows north and west to Meadow Portage. It also includes the land bordering the southern end of Lake Winnipegosis including Waterhen Lake and River on its eastern side.

The subsoil which underlies most of this country is very gravelly, and there are numerous gravel ridges.

The area is a whole is better suited to stock raising and dairying than to any other branch of agriculture.

Four subdivisions of this area will now be considered separately.

Moosehorn Area. The Moosehorn area is located approximately as follows: it extends from Lake Manitoba east, to the east boundary of range 6 west of the principal meridian, and from township 25 to township 30 (inclusive).

The country is nearly level or gently undulating, and for the most part is lightly wooded. Wild hay meadows are numerous in the western and northern portions. The principal occupations of the settlers are dairying and stock raising. Good well water is readily obtainable, as a rule.

About 60 per cent. of the quarter sections were classed as grazing land, and the percentage of good cultivable land is really quite small.

Gypsumville Area. The Gypsumville area is located at the north end of Lake Manitoba, approximately as follows: townships 31 to 33 (inclusive) and ranges 7 to 11 (inclusive) west of the principal meridian.

There are about 1,000 quarter sections in the area, of which about 37 per cent. were classed as fit for grazing only, about 45 per cent. as requiring extensive improvements, and only about 11 per cent. as economically improved, or improvable, for agricultural purposes.

The soils vary greatly, with lighter soils to the north, and loam or clay loam to the south. Swamps are scattered all over the area. Good water is plentiful in most of the townships.

[12] Information regarding the following area was obtained from the land-classification map of the District Adjacent to Lakes Winnipegosis and Manitoba on the scale of 5 miles to the inch, Topographical Survey, Department of the Interior. See also the Geological Survey report cited above in footnote 5.

Waterhen Area. The Waterhen area surrounds Waterhen Lake. The area is located approximately as follows: townships 32 to 28 (inclusive) and ranges 15 and 16 west of the principal meridian. The territory is difficult of access at present.

The soil is mainly loam or sandy loam on a stony clay subsoil, and there are many meadows and marshes. The area is well supplied with natural sources of water.

Owing to its inaccessibility and to the comparatively few really good quarter sections in the area, it is not recommended for settlement, except in the vicinity of the larger hay meadows, where ranching may be carried on successfully.

Winnipegosis Area.[12] The surveyed area is a tract of land at the southern end of Lake Winnipegosis, in townships 30 to 37 and ranges 16 to 23 west of the principal meridian.

TABLE X—SOILS OF WINNIPEGOSIS AREA (APART FROM SWAMPS AND OUTCROPS)*

	SQUARE MILES	ACRES
Aeolian soils: dune sand	5	3,200
Beach soils: gravelly sand and coarse sand	28	17,920
Lacustrine soils: fine sand and sandy loam	145	92,800
Glacial till soils:		
Clay loam and clay	694	444,160
Stony clay	20	12,800
Total area	892	570,880

* Canada Geological Survey Memoir 128, p. 15.

The highest part of the area is along the face of Duck Mountain (the mountain is really an upland or plateau). The most striking topographical feature of the lacustrine deposits which occur chiefly in the western and southwestern parts, is a series of long, narrow gravelly beach ridges trending parallel to the front of Duck Mountain. The greater part of the area east of Lake Winnipegosis is only a few feet above the level of the lake.

Swamps are numerous and difficult to drain. The soils are practically all drift soils, and as a whole are calcareous. The forest growth consists mostly of small trees, poplars being most abundant.

The total area mapped is 1,418 square miles, of which about 2 square miles are bed rock outcrop and 524 (or about 37 per cent.) are swamps. Table X, above, gives the areal distribution of the soils, exclusive of those portions occupied by swamps and outcrops.

The fine sand and sandy loam lacustrine soils are usually free from stones, and for the most part well supplied with organic matter. In places they are poorly drained, owing to the nearly level surface.

The clay loam and clay glacial till soils occupy about half the total area. They usually have stony subsoils, and the surface is stony in places. They

[12] Although this area is shown on the land-classification map of the Topographical Survey, additional information was obtained from W. A. Johnston, *Winnipegosis and Upper Whitemouth River Areas, Manitoba: Pleistocene and Recent Deposits* (Ottawa: Department of Mines, Geological Survey Memoir 128, 1921), with Map 1771 on the scale of 3 miles to the inch.

are usually naturally drained, and their stony character is their chief objectionable feature.

Natural hay meadows occur among the wet bogs of the swamp lands.

The water supply in the west is abundant and good. The waters of many of the small lakes are somewhat salty, and, owing to salt and mineral springs, it is difficult in parts of the area to obtain water for domestic purposes.

Upper Whitemouth River Area[14]

The Upper Whitemouth River Area covers nearly 3,500 square miles in the southeastern corner of Manitoba. Of this, 2,650 square miles have been mapped; the remaining part is difficult of access in summer because of extensive swamps The area is located in townships 1 to 10 (inclusive) and ranges 8 to 18 (inclusive) east of the principal meridian.

TABLE XI—SOILS OF THE UPPER WHITEMOUTH RIVER AREA*

	SQUARE MILES	ACRES
Swamp: muck and peat	1,447	926,080
Aeolian: dune sand	10	6,400
Alluvial: fine sand and sandy loam	12	7,680
Beach: gravelly sand and coarse sand	49	31,360
Lacustrine:		
Fine sand	343	219,520
Sandy loam	88	56,320
Clay loam and clay	18	11,520
Glacial till:		
Fine sandy loam	263	168,320
Stony loam	96	61,440
Fine sand and sandy loam	184	117,760
Bed rock	140	89,600
Total area	2,650	1,696,000

* Canada Geological Survey Memoir 128, Part II, with Map 1802 on the scale of 3 miles to the inch

The area may be divided into two parts: a rocky area with numerous lakes in the northeast, similar to the great area east of Lake Winnipeg, and a deeply drift covered area in the southwest.

Throughout the area large swampy tracts are prevalent. In many places low ridges of sand and gravel, marking shore lines of an ancient lake, act as dams and prevent natural drainage. Marshes forming natural hay meadows occur chiefly in the western and southwestern parts of the area.

Most of the trees of the area are coniferous, the jack pine predominating Spruce and tamarack occur on the peat bogs.

The soils are generally calcareous, except in the northeast, where, overlying Precambrian rocks, the soils are only slightly calcareous.

It will be observed that the swamp soils cover a very large proportion of the area. The peat areas are relatively large and the muck areas relatively small.

The lacustrine soils are generally free from stones or boulders, but the natural drainage of these soils is poor in places. The glacial till soils, on the other hand,

[14] *Op cit.*, p. 34.

TABLE XII—CHEMICAL COMPOSITION OF SEVERAL ALBERTA, SASKATCHEWAN, AND MANITOBA SOILS*

HORIZON	DEPTH (in inches)	NITROGEN (per cent)	PHOSPHORUS (per cent)	REACTION† pH
	Second-Class Grey Timber Soil near Fort Vermilion, Alberta			
A_1	0–2	42	06	7 2
A_2	2–6	04	.059	6 4
A_3	6–10	04	046	6 2
	First-Class Grey Timber Soil near Peace River Town, Alberta			
A_1	0–4	506	121	7 2
A_2	4–6	161	080	6 8
B_1	6–18	102	055	6 2
	Black-Grey Transitional (Park) Soil near Peace River, Alberta			
A_1	0–6	55	077	6 0
A_2	6–12	143	046	5 6
B_1	12–28	125	050	5 8
	First-Class Grey Timber Soil near Lac La Biche, Alberta			
A_1	0–2	.313	.064	6.7
A_2	2–6	.049	.055	6.8
A_3	6–14	.054	.078	6 6
	Black Park Soil—Loam near Edmonton, Alberta			
A_1	0–12	.52	.15	7 1
A_2	12–22	.11	05	7 1
B_1	22–36	08	06	6 9
	Brown Prairie Soil—Loam near Benton, Alberta			
A_1	0–5	23	07	7 8
A_2 or B_1	5–9	14	06	7 7
B_2	9–21	08	05	7 7
	Grey Timber Soil—Loam near Crooked River, Sask.			
A_1	0–1	341	100	7 5
A_2	1–8	067	050	6 8
B_1	8–14	.071	050	7 7
	Grey Timber Soil—Loam near St. Walburg, Sask.			
A_0	0–2	1 55	.114	7 3
A_1	2–2½	.186	.031	7 3
"	2½–7½	030	.012	6 9
	Black Park Soil—Oxbow loam, Sask			
	0–4	546	075	
...	4–10	216	.062	.
...	10–26	.099	.050	
	Brown Prairie Soil—Fox Valley silt loam, Sask			
..	0–4½	245		7 3
.	4½–8	.148		8 2
.	8–20	088	. .	8 7
	Grey Timber Soil—Near Eriksdale, Man.			
.	0–7	270	033	
	7–20	046	015	
	Black Park Soil—Gilbert Plains loam, Man.			
.	0–7	.411	.038	
	7–20	.091	.024	
	Black Meadow Soil (Red River Valley)—Osborne clay, Man.			
..	0–7	.409	.082	.
..	7–20	181	.073	...

* The Alberta and Saskatchewan samples were taken according to profile or natural soil layers, and the Manitoba samples according to predetermined depth.

† Acid reaction expressed in concentration of hydrogen ions

are frequently stony, but their natural drainage is usually satisfactory. The percentage of good agricultural soil in the area, as a whole, is small

The average annual precipitation is probably about 22 inches Water for stock is generally abundant and satisfactory.

Analysis of Typical Soils of the Prairie Provinces

Table XII shows the partial analysis of a number of Alberta, Saskatchewan, and Manitoba soils. Attention is called to the fact that the surface layer, rich in nitrogen and other plant food elements, is usually relatively thick in the case of the black park and black-grey transitional or park soils The surface layer of the brown prairie soil is not as rich in nitrogen or organic matter In the case of the grey timber soils the surface layer rich in nitrogen and organic matter is thinner. The third-class grey forest soil usually possesses a relatively thin surface layer, and sometimes this layer is practically absent

Table XIII—Various Soil Types on the Medicine Hat Sheet*

Soil Types	Acres	Per Cent of Total
Fine sand	256,300	9 3
Fine sandy loam	209,600	7 4
Loam	606,400	22 1
Loam (rolling phase)	294,400	10 6
Loam (hilly phase)	361,600	13 0
Silt loam	365,400	13 2
Silt loam (rolling phase)	137,600	4 9
Silt loam (blow-out phase)	135,200	4 9
Clay loam	11,300	0 4
Clay	57,800	2 1
Mixed areas	93,800	3 4
River bottom	13,100	0 4
Eroded	219,700	7 8
Lakes	15,500	0 5
Total	2,777,700	100 0
Actual area	2,764,800	

* University of Alberta, College of Agriculture, Bulletin No 14 (see footnote 7), p 23

Estimates of Land Suitable for Cultivation

The discussion of soils so far has been concerned with the soils of the pioneer fringe where settlement is or has recently been active The soils of the Prairie Plains and Park Belt have already been described generally (pp. 20-25), and the results of soil surveys in these sub-regions have been published (footnote 7) It is desirable, however, to attempt to summarize in quantitative form the information which is available, to translate it into categories significant for the purposes of settlement, and to venture quantitative generalizations for the whole region of the Prairie Provinces.

The Brown Prairie Soil Zone

This soil zone has an area of approximately 34,000,000 acres, of which 13,000,000 acres are in Alberta and 21,000,000 acres are in Saskatchewan

Soil survey reports have been published for two areas in Alberta, Medicine Hat and Sounding Creek (marked "Bull. 14" and "Bull. 16" on Fig. 159), lying wholly within the brown soil belt. The proportion of various soil types in these areas are shown in Tables XIII and XIV. Since these two surveys cover 5,529,000 acres or nearly half of Alberta's brown soil zone, their results may fairly be taken as representative of the whole of that zone in Alberta.

In attempting to divide these soil types (from the standpoint of cultivation or grain growing) into first-, second-, and third-class brown prairie soils, numerous factors should be considered, and the succeeding percentage and acreage figures must be regarded as rough estimates. It is evident that first-class land is often quite unsatisfactory for grain growing in the brown prairie soil zone, because of lack of moisture It is also evident that land belonging to the third class from the standpoint of grain growing, is often quite satisfactory for pasture purposes. Then, since detailed surveys were not conducted, there is considerable

TABLE XIV—VARIOUS SOIL TYPES ON THE SOUNDING CREEK SHEET*

SOIL TYPES	ACRES	PER CENT OF TOTAL
Sand	60,928	2 3
Sandy loam	245,499	8 8
Coarse sandy loam	9,504	0 3
Loam	1,231,577	44 6
Silt loam	244,656	8 8
Clay loam	81,200	3 0
Clay	51,066	1 8
Blow-out loam	635,482	23 1
Mixed	51,608	1 8
Eroded	118,760	4 3
Alkali	15,213	0 5
Water	19,307	0 7
Total	2,764,800	100 0

* University of Alberta, College of Agriculture, Bulletin No. 16 (see footnote 7), p. 18.

variation within a given soil type in many cases, and the type may be partly in one class and partly in another.

In dividing the soil types into three divisions significant for the purpose of settlement, it is therefore stated that those of the first division may be first- or second-class types, and those of the second division may be second- or third-class types. Certain other types may be fairly definitely placed in the third class, from the standpoint of grain growing. The three divisions were then made as follows:

Division 1: loams, silt loams, and clay loams.

Division 2: medium and fine sandy loams, clays, "blown-out" or "burnt-out" loams and silt loams, and mixed areas.

Division 3: sands, hilly loams, eroded areas, alkali areas.

The percentages and areas of the various classes of soil in Alberta's brown prairie soil zone, estimated as just explained, are given in Table XV.

Table XVI shows the approximate percentage of the surveyed area occupied by the various soil types and land classes of southwestern Saskatchewan. This

area extends from the third meridian on the east to the Alberta boundary on the west, and from the top of township 16 on the north to the international boundary on the south (area marked "Rept. 9" on Fig. 159) and covers almost 11,000,000 acres, about one-half of Saskatchewan's brown soil zone.

These Saskatchewan soil types may be roughly separated, from the standpoint of cultivation or grain growing, into three divisions similar to the Alberta brown prairie soil divisions previously discussed. The factors and qualifications considered in the discussion of this classification of Alberta soils apply to the classification of Saskatchewan soils also.

Division 1: (first- and second-class brown prairie soil types): light loams, loams, silt loams, silty clay loams, and clay loams.

Division 2: (second-and third-class brown prairie soil types): sandy loams, rolling to steep loams, "burnt-out" or "blown-out" clay loams.

Division 3: (third-class brown prairie soil types): sands, rough and hilly lands, dissected plateau lands, low and poorly drained lands.

Table XVII shows the percentage and areas of the various classes of soil in Saskatchewan's brown prairie soil zone estimated as previously explained.

TABLE XV—ESTIMATED AREAS OF GENERAL CLASSES OF SOIL IN ALBERTA'S BROWN PRAIRIE SOIL ZONE

	DIVISION 1 FIRST- AND SECOND-CLASS TYPES	DIVISION 2 SECOND- AND THIRD-CLASS TYPES	DIVISION 3 THIRD-CLASS TYPES
Medicine Hat Sheet soil survey...	51 per cent.	19 per cent.	30 per cent.
Sounding Creek Sheet soil survey.	56 per cent.	36 per cent.	8 per cent.
Approximate average.....	53 per cent.	27 per cent.	20 per cent.
Estimated acres.	6,890,000	3,510,000	2,600,000

The Dark Brown Prairie and Black Park Soil Zones

Tables showing the extent of the different soil types over a large proportion of the dark brown prairie and black park soil zones are not available. However, the original soil material consisted mainly of glacial till rather similar to that from which the brown prairie soils were formed. Therefore, it may be suggested that the proportions of good, medium, and poor soils in all three zones are about the same. Of course it must be remembered that because of climatic and other conditions the black park soils are more productive on the whole than the dark brown prairie soils, and the dark brown more productive than the brown prairie soils.

Table XVIII shows the approximate number of acres in each of the three soil divisions, if we assume that about 50 per cent. of the dark brown prairie and black park soil zones consist of satisfactory cultivable land, 25 per cent. of rather poor or marginal land, and 25 per cent. of land unfit for cultivation, though probably suitable for pasture land.

The Black Meadow Soil Zone

In the case of the black meadow soil zone of Manitoba, formed on comparatively level lacustrine deposits, it is evident that the proportion of satisfactory cultivable land is larger than in the case of the soils formed mainly on

glacial till material. If we assume that about 70 per cent. of the black meadow soil zone consists of satisfactory cultivable land, that about 15 per cent. consists of rather poor or marginal land from the standpoint of cultivation, and that about 15 per cent. consists of land unfit for cultivation, the areas will be about as follows:

Satisfactory for cultivation	1,400,000 acres
Marginal for cultivation	300,000 acres
Not suitable for cultivation	300,000 acres

The Grey Timber and Black Park Transitional Soil Zone

The results of the soil surveys of these zones have already been summarized (pp. 207-226). It is necessary to bring these results together and apply them as far as is permissible to the areas not covered by soil surveys.

TABLE XVI—APPROXIMATE PERCENTAGES OF THE TOTAL SURVEYED AREA IN SOUTHWESTERN SASKATCHEWAN (17,080 SQUARE MILES) OCCUPIED BY THE VARIOUS SOIL TYPES AND LAND CLASSES*

SOIL TYPES AND LAND CLASSES	PER CENT. OF TOTAL AREA
Sceptre silty clay	0 4
Sceptre silty light clay	0 4
Fox Valley silty clay loam	2 5
Fox Valley silt loam	1 0
Fox Valley loam	0 7
Fox Valley silt loam and loam (mixed)	0 9
Haverhill silty clay loam	0 2
Haverhill clay loam	3 3
Haverhill clay loam (rolling)	3 1
Haverhill clay loam (rolling to steep)	0 2
Haverhill loam	7 8
Haverhill loam (rolling)	11 8
Haverhill loam (rolling to steep)	8.3
Haverhill clay loam and loam (mixed)	1 5
Haverhill loam and silt loam (mixed)	0 8
Haverhill light loam	1 2
Haverhill loam and fine sandy loam (mixed)	2 0
Haverhill sandy loams	3 7
Cypress loam and light loam (mixed)	3 7
Cypress clay loam	0 3
Cypress clay loam and loam (mixed)	0 2
Wood Mountain clay loam	0 1
Wood Mountain loam	2 2
Hatty sandy loams	4 0
Echo clay loam (blown-out)	11 4
Haverhill and Cypress clay loam (mixed)	0 6
Haverhill and Cypress loam and light loam (mixed)	1 7
Sands	4 1
Rough and hilly lands	12 9
Dissected plateau lands	4 1
Lowland, poorly drained	4 7
Podzol (grey wooded)	0 1

* University of Saskatchewan, College of Agriculture Report No 9 (see footnote 7), p. 80

TABLE XVII—ESTIMATED AREAS OF GENERAL CLASSES OF SOIL IN SASKATCHEWAN'S BROWN PRAIRIE SOIL ZONE

	DIVISION 1 SECOND- AND THIRD-CLASS TYPES	DIVISION 2 SECOND- AND THIRD-CLASS TYPES	DIVISION 3 THIRD-CLASS TYPES
Southwestern Saskatchewan soil survey	46 per cent.	28 per cent	26 per cent.
Estimated acres	9,660,000	5,880,000	5,460,000

The Alberta section of this zone has been more thoroughly surveyed than the other sections. The classification of soils (set out in Tables I-VIII) is summarized in Table XIX. In addition estimates based on land classification maps have been made for three important districts not covered by the Alberta soil surveys.

Certain muskeg, eroded, and rough areas covered by the surveys but not suitable for cultivation are not included in the estimates contained in Table XIX.

In general it is considered that park soils and first-class timber soils are satisfactory for cultivation, that second-class timber soils are marginal for cultivation and that third-class timber soils are not suitable for cultivation (see p. 212). On this basis the districts listed in Table XIX contain the following areas of the three general classes of soil.

Satisfactory for cultivation	4,650,000 acres
Marginal for cultivation	6,000,000 acres
Not suitable for cultivation	10,000,000 acres

There are about 9,000,000 acres (exclusive of the Swan Hills area) in the large triangular area of grey timber soil shown on the map (Fig 24) between Alberta's main black soil zone on the east, the south side of township 69 on the north, and a line drawn through Edson and Rocky Mountain House on the west. There are some fairly large tracts of good cultivable land in certain parts of this area. If we assume that about 20 per cent. of the area consists of satisfactory cultivable land, that about 30 per cent consists of rather poor or marginal

TABLE XVIII—ESTIMATED AREAS OF GENERAL CLASSES OF SOIL IN THE DARK BROWN PRAIRIE AND BLACK PARK SOIL ZONES OF THE THREE PRAIRIE PROVINCES

	SATISFACTORY FOR CULTIVATION (acres)	MARGINAL FOR CULTIVATION (acres)	NOT SUITABLE FOR CULTIVATION (acres)
Alberta: dark brown prairie soil zone	6,500,000	3,250,000	3,250,000
Alberta: black park soil zone	4,000,000	2,000,000	2,000,000
Saskatchewan: dark brown prairie soil zone	8,500,000	4,250,000	4,250,000
Saskatchewan black park soil zone	11,500,000	5,750,000	5,750,000
Manitoba: black park soil zone	4,750,000	2,375,000	2,375,000

land from the standpoint of cultivation, and that about 50 per cent. consists of land unfit for cultivation, the acreages will be about as follows:

Satisfactory for cultivation	1,800,000 acres
Marginal for cultivation .	2,700,000 acres
Not suitable for cultivation ..	4,500,000 acres

The transitional grey timber and black park soil zone of Saskatchewan, as far as its boundaries have been defined, covers about 15,000,000 acres. If we assume that about 10 per cent of this zone consists of satisfactory cultivable land, that about 20 per cent. consists of rather poor or marginal land from the standpoint of cultivation, and that about 70 per cent. consists of land unfit for cultivation, the areas will be about as follows:

Satisfactory for cultivation	1,500,000 acres
Marginal for cultivation	3,000,000 acres
Not suitable for cultivation .	10,500,000 acres

The transitional grey timber and black park soil zone of Manitoba contains some large areas of good soil. We may assume that about 40 per cent. of this

TABLE XIX—ESTIMATED AREAS (in acres) OF GENERAL CLASSES OF SOIL IN NORTHERN ALBERTA AND THE PEACE RIVER BLOCK

	Black Park Soils	Grey Timber Soils		
		First Class	Second Class	Third Class
(a) In surveyed districts —				
Fort Vermilion area .	36,960	440,970	2,105,550	1,413,920
Whitemud and Battle River areas	73,900	82,900	181,800	1,266,100
Keg River area	10,900	52,800	23,000	97,600
Area adjacent to Peace River west of Dunvegan	579,570	548,295	762,655	481,055
Area between Aggie and Bezanson	18,880	139,520	1,284,320	127,840
Area between Peace River and Grouard	66,680	264,080	420,380	1,305,860
Area north and west of Athabaska		50,920	88,320	1,071,320
Lac La Biche area .	.	107,136	145,792	854,178
Area between Cold Lake and Cheecham	.	72,480	66,080	1,170,080
(b) In districts settled, but not covered by soil surveys —				
Grande Prairie area*	650,000	160,000		. . .
Area from Grimshaw to Dunvegan*	400,000	286,000	357,000	. .
Peace River Block of British Columbia†	284.000	331,000	646,000	2,239,000
Total	2,120,890	2,536,101	6,080,897	10,026,953

* Estimated from Map of Part of Peace River district, Showing Classification of Lands by Quarter Sections for Settlement, scale 6 miles to the inch, Topographical Survey, Ottawa, 1929

† See p. 218. Open grassland assumed to be park soils; light forest cover, first-class timber soils, medium forest cover, second-class timber soils, all other, third-class timber soils

zone consists of satisfactory cultivable land, that about 30 per cent. consists of rather poor or marginal land from the standpoint of cultivation, and that about 30 per cent. consists of land unfit for cultivation. The areas will be about as follows:

Satisfactory for cultivation	2,200,000 acres
Marginal for cultivation	1,650,000 acres
Not suitable for cultivation	1,650,000 acres

Grey Timber High-Lime Peat Soil Zone

That part of the grey timber and high-lime peat soil zone of Manitoba which lies on both sides of Lakes Manitoba and Winnipegosis and west of Lake Winnipeg covers about 10,000,000 acres. Agriculturally the soils of this zone may be regarded as mainly marginal or sub-marginal (Figs. 51 and 53). Assume that about 10 per cent. of this zone consists of satisfactory cultivable land, that about 20 per cent. consists of rather poor or marginal land from the standpoint of cultivation, and that about 70 per cent. consists of land unfit for cultivation, and the areas will be about as follows:

Satisfactory for cultivation	1,000,000 acres
Marginal for cultivation	2,000,000 acres
Not suitable for cultivation	7,000,000 acres

Conclusion

The estimates of the area of land suitable for cultivation which have now been made for each of the soil zones are summarized in Table XX. The amounts for the whole region are thus obtained. It should be repeated that these quantities are only rough estimates, although based on the careful scrutiny of the results of all soil surveys. They are, it is believed, the best estimates which can be made on the available information.

Table XX—Summarized Estimates of Soils Satisfactory for Cultivation, Marginal for Cultivation, and Unsuitable for Cultivation in the Soil Zones of the Three Prairie Provinces and of the Peace River Block of British Columbia

	Satisfactory for Cultivation (acres)	Marginal for Cultivation (acres)	Not Suitable for Cultivation (acres)
Brown prairie soil zone	16,550,000	9,390,000	8,060,000
Dark brown prairie soil zone	15,000,000	7,500,000	7,500,000
Main black park soil zone	20,250,000	10,125,000	10,125,000
Black meadow soil zone	1,400,000	300,000	300,000
Grey timber and black park transitional soil zone	10,150,000	13,350,000	26,650,000
Grey timber high-lime peat soil zone	1,000,000	2,000,000	7,000,000
Total	64,350,000	42,665,000	59,635,000

TABLE XXI—AGRICULTURAL LAND IN THE PRAIRIE PROVINCES*

	TOTAL LAND AREA (acres)	TOTAL AGRICULTURAL LAND (acres)
Alberta	159,232,000	97,123,000
Saskatchewan	152,304,000	93,498,000
Manitoba	143,857,000	24,700,000
Total	445,393,000	214,321,000

* *Canada Year Book, 1932* (Ottawa. Dominion Bureau of Statistics, 1933), p. 39.

In contrast with the foregoing, the *Canada Year Book* gives the estimate contained in Table XI.

There are two reasons for the wide discrepancies in these two tables—214,000,000 against 107,000,000 acres of agricultural land.[15]

In the first place, certain unsurveyed areas which lie wholly within the timber soil belt, and for the greater part, within the boundaries of the Precambrian Shield, have been excluded from the first estimate. These areas include a large section in the northeast quarter of Alberta (about 50,000,000 acres), the mountain districts and some smaller areas in northern Alberta, almost the whole of the province of Saskatchewan north of a line drawn from Cold Lake to where the Saskatchewan crosses the Manitoba boundary (more than 60,000,000 acres), the greater part of the province of Manitoba—that lying north and east of the lakes (upwards of 100,000,000 acres). While these areas are excluded from the estimate here given, because they have not been systematically surveyed, yet the available evidence has been reviewed, and it is confidently predicted that no large tracts of land suitable for cultivation and capable of supporting independent settlement will be found in them. There are, however, many areas where land will be cultivated, if settlement is promoted by some other industry, such as mining or lumbering.

In the second place, "agricultural land", as used in the *Canada Year Book* estimate, includes not only arable but also grazing land and wood lots. It includes land similar to that which is being used for agriculture in other parts of Canada. In the estimate offered here, grazing and wood lots are not included. It is assumed that a certain proportion of the land classed as not suitable for cultivation will be utilized where sufficient arable land is available to make up a productive enterprise. The primary purpose of the estimate given in Table XX is to furnish information concerning the quantity of land suitable for settlement in the immediate or near future and under conditions similar to those which have obtained over the past decade. It is considered that both land classed as satisfactory for cultivation and marginal for cultivation may reasonably be made available for settlement.

In the three Prairie Provinces and in the Peace River Block of British Columbia it is estimated that upwards of 107,000,000 acres of land falls into these two classes. In 1931, the area of land in farms in this region was 109,778,000 acres,

[15] Note also that the 3,500,000 acres of the Peace River Block of British Columbia are not included in Table XXI.

of which only 59,854,000 acres were improved.[16] Since occupied land in natural pasture or other unimproved forms in 1931 totalled 50,000,000 acres, and since only a moderate proportion (not more than half) of this could be considered suitable or marginal for cultivation, it follows that probably 84,000,000 acres of satisfactory or marginal land were already occupied and that at least 20,000,000 acres of similar land, reasonably accessible, with larger areas of woodland and pasture, remained in 1931 available for settlement.[17] This is equal to the amount of land added to occupied acreage between 1926 and 1931.[18] On the basis of the *Canada Year Book* estimate of agricultural land, 105,000,000 acres of agricultural land were available for occupation in 1931. Even making generous allowance for utilization of woodland and of natural pasture, this estimate is far too large, or at least is not helpful in planning present settlement policy.[19]

It must be remembered, of course, that the poorer soils of the wooded belt, the true podzols, and the bog soils, are capable of extensive amelioration. No absolute limit can be set to the possibilities of soil utilization. Anything may be accomplished at a price. Many unpromising farms will be turned into profitable enterprises by the ingenuity and persistence of their operators. Where other industries provide a local market, soils may be profitably utilized which could not compete in the production of "export" crops. Under the stimulus of higher average prices than have been experienced during the period of the settlement of the Canadian plains, much sub-marginal land could be brought into production. The above estimates are concerned only with what is practicable in the immediate future under conditions similar to those which have been experienced in the past.

[16] "Total Number of Farms, Farms Tenure, Farm Acreage, Farm Values, Mortgage Debt, Farm Expenses", *Census of Agriculture, Preliminary Report* (Ottawa Dominion Bureau of Statistics, 1932), p 6

[17] Dr J. D. Newton is not responsible for this deduction from his estimates —W.A M

[18] Census of Agriculture, Preliminary Report, p 4.

[19] Jenness has estimated that in the whole of Canada there is a total area of arable land of less than 150,000,000 acres, of which about half is in the Prairie Provinces. Since in 1931, 60,000,000 acres of land in these provinces were improved, it would follow from Jenness's estimate that there remained there only 15,000,000 acres of agricultural land, whether occupied or unoccupied, which can profitably be improved This estimate is altogether too low. See Diamond Jenness, "The Population Possibilities of Canada", *University of Toronto Quarterly* I (1932), p 392.

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